

# *Chemical Engineering*

JANUARY 1955

## CAN YOU ...

**Read your slide rule to 4 places?**

A prizewinning idea

**End hot spots in boiler tubes?**

A prizewinning idea

### Cut off viscous stringy flow?

### Solve saturated-air problems?

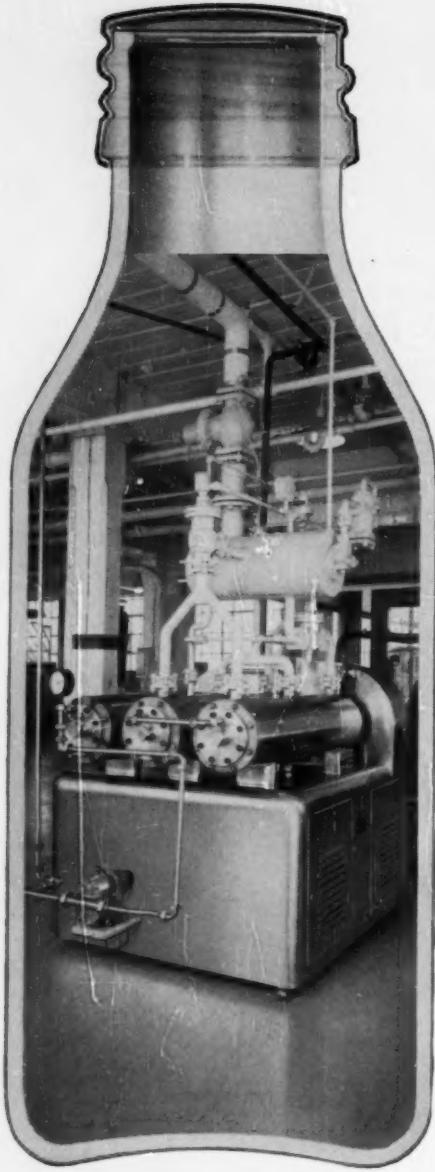
Get specific heats over wide ranges? →

#### **Position agitator propellers properly?**

**See the Plant Notebook starting on page 204**

A MCGRAW-HILL PUBLICATION

ONE DOLLAR



**GIRDLER DESIGNS** processes and plants

**GIRDLER BUILDS** processing plants

**GIRDLER MANUFACTURES** processing apparatus

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| Sulfation          | Textile Size       | Paraffin Wax  |
| Nitration          | Shaving Cream      | Synthetic Wax |
| Crystallization    | Lubricating Grease | Resins        |
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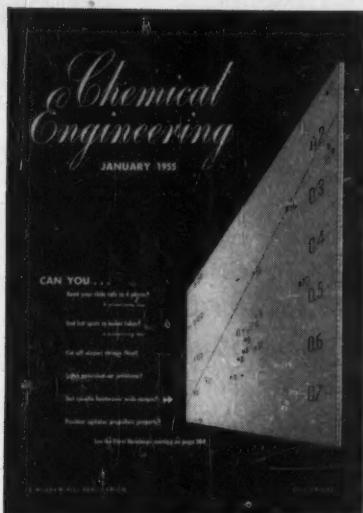
The **GIRDLER** Company

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LOUISVILLE 1, KENTUCKY

VOTATOR DIVISION: New York, Atlanta, Chicago, San Francisco  
GAS PROCESSES DIVISION: New York

## GUIDED TOUR

JOHN R. CALLAHAM, EDITOR



• • •

### Seven more tested shortcut solutions to everyday engineering problems.

This month—and every month—CE's Plant Notebook brings you a wealth of time-saving shortcuts, calculations and solutions. In this issue you'll find a tricky way to read your slide rule to four places, how to cut off flow of viscous liquids, a chart giving specific heats of 18 fluids, nomograph to solve saturated-air problems, quick way to leak-proof pilot plant joints, best way to position an agitator, how to end these troublesome hot spots in boiler tubes. (p. 204)



### What We Promise for '55

We've studied your likes and dislikes. So here's our promise:

- Special reports on distillation, photochemical engineering, mechanical separations, drying, biochemical engineering, moving bed processes.
- Continued efforts to keep feature articles and departments clippable without destroying adjacent articles.
- Continuation, by unanimous request, of Refresher department.
- More articles on costs, cost estimating techniques, engineering economics (see articles in this issue).
- Broader coverage of industry and commodity economics (see Chemical Economics in this issue).
- A second annual Inventory Issue, refined and with added features.
- Continued efforts to discourage the excessive mixing of ads and editorial on the same page.
- Broader coverage of new process and technology developments (see What's Happening), more emphasis on theory as it relates to practice, legible drawings, readable text, close attention to your needs—JRC.

### How's your cooling tower working?

That's not easy to answer. For one thing, precious little's been published to give the operating or design engineer practical data for use on his own plant unit. At last, here's an article that does. (p. 187)



### How they picked the right bid.

Here's a step-by-step case history of how Dow engineers went about comparing evaporator bids from four major firms. The



**Please turn page**

## GUIDED TOUR



approach they used can also save you money and headaches in evaluating bids. (p. 181)



### Try semi-countercurrent extraction.

When batch leaching doesn't justify multiple fresh solvent contact or countercurrent methods, a compromise—partial counter-current—may do the trick. George Karnofsky tells how and why. (p. 192)



### Gas turbines for process use.

These versatile devices can turn out power, steam and compressed air in just about any proportion, and new developments open up a big future in processing work. An article for engineers who look ahead. (p. 175)

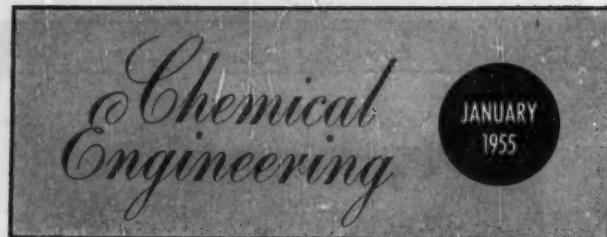


### New look in chemical economics.

Take a fresh look at this month's Chemical Economics department. It's bigger, better, more prominent than ever—just what you've asked for. (p. 171)



Rejoin GUIDED TOUR page 266



CHEMMENTATOR ..... 99

### WHAT'S HAPPENING IN CHEMICAL ENGINEERING

|  |     |
|--|-----|
| Polyvinyl Alcohol Synthetic Fiber Picture..... | 108 |
| Powder Traces Pollution Patterns.....          | 114 |
| Dispersant Cuts Cost of Spray Drying.....      | 118 |
| Ion Exchange Sweetens Sugar.....               | 122 |
| Predicted Pressure Drop Proved in Field.....   | 126 |
| Formula for Research Expense.....              | 130 |

### CHEMICALS AND RAW MATERIALS

|  |     |
|--|-----|
| Separate Men From Boys.....              | 136 |
| Index to this month's new chemicals..... | 138 |

### FEATURE ARTICLES

|  |     |
|--|-----|
| Keep Cost Estimates Realistic.....       | 171 |
| <i>C. A. Butler, Jr.</i>                 |     |
| Gas Turbines for Process Use—I.....      | 175 |
| <i>Benjamin Miller</i>                   |     |
| Guide for Picking the Right Bid.....     | 181 |
| <i>E. E. Ludwig and A. F. Shorkey</i>    |     |
| Solve for Payout Time.....               | 185 |
| <i>E. Yanagisawa</i>                     |     |
| Counter-Flow Cooling Towers.....         | 187 |
| <i>Jack Whitesell</i>                    |     |
| Get Semi-Countercurrent Extraction.....  | 192 |
| <i>George Karnofsky</i>                  |     |
| How to Design Gas-Cooling Towers—II..... | 195 |
| <i>G. H. P. Bras</i>                     |     |

### CE REFRESHER

|  |     |
|--|-----|
| Catalytic Vapor Phase Reactions—I..... | 199 |
| <i>Thomas E. Corrigan</i>              |     |

## PLANT NOTEBOOK

Read Your Slide Rule to Four Figures ..... 204  
*Royes Salmon*



## YOU AND YOUR JOB

Employment Prospects for 1955 ..... 216

## CORROSION FORUM

Rubber Hose Gets Better ..... 224  
*J. A. Muller*  
Lead Lined Plus ..... 230

## TOMORROW'S TECHNOLOGY

New Reactor Scrubs NH<sub>3</sub> From Coke Oven Gas ..... 236  
Chlorination via Photochemistry ..... 240  
Your Checklist of New Patents ..... 242

## EQUIPMENT NEWS

Ball Transmission Tilts to Vary Speed ..... 248  
Index to this month's new equipment ..... 250  
Equipment Cost Index ..... 250  
Two-in-One Compressor ..... 252

## CHEMICAL ECONOMICS

Why 1955 Will Be Chemicals' Best Year ..... 266  
Consumption Index ..... 268  
Fertilizers: Piling Up? ..... 270

## PICTURED FLOWSHEET

Semi-Chemical Pulp ..... 300

## OTHER DEPARTMENTS

Book Reviews ..... 320  
Convention Calendar ..... 114  
Firms in the News ..... 326  
Names in the News ..... 307  
Recent Pamphlets ..... 324  
Technical Literature ..... Reader Service

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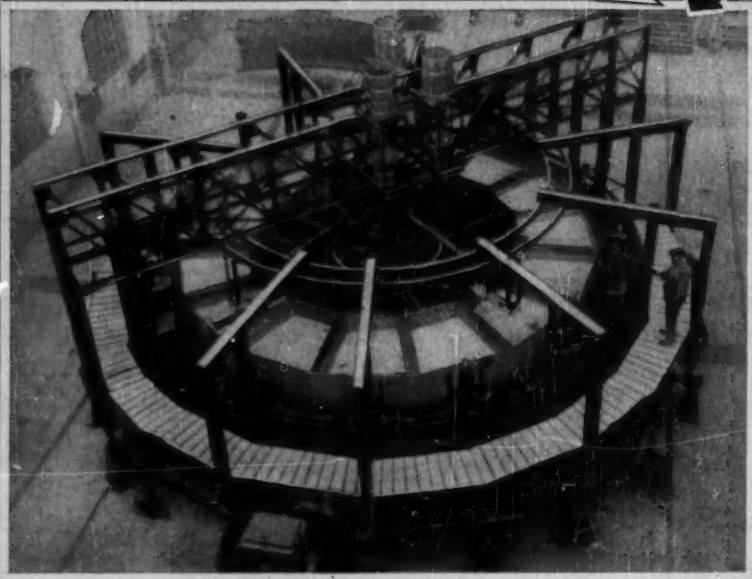
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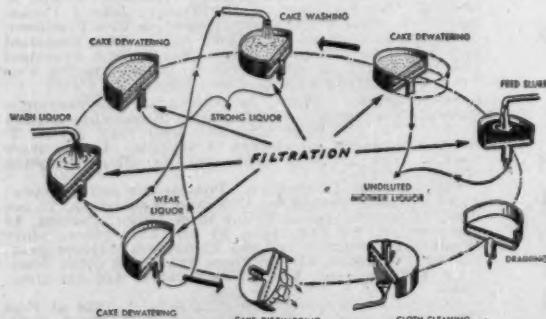
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COOPER ALLOY

## CORPORATION BRIEFS

• Edited by GEORGE BLACK

### ELC CAPACITY EXPANDED

To meet the increased demand for ELC grade, the extra low carbon stainless steel which permits welding without subsequent heat treatment, our Foundry Products Division has expanded its melt capacity by more than six tons per day. The cost cutting advantages of cast-weld construction plus the increasing number of processes requiring field fabrication seem to be the stimulus.



### NEW DISTRIBUTORS ADDED

Thought you might like to know that the following companies have recently become authorized distributors of our stainless steel valves and fittings:

- Mills & Lupton Supply Co.  
Chattanooga, Tennessee
- All-Stainless, Inc.  
Boston, Mass.
- John B. Hack & Co.  
Woodbury, New Jersey
- Tay-Holbrook & Co.  
San Francisco, Calif.



### NEW PLANT UNDER WAY

Construction has been started on our new Aircraft Products Manufacturing plant at Clark, New Jersey. We're particularly proud of the developments behind this new plant, because they will save the government more than a million dollars a year, while making it possible to produce jet engine ring components faster and with appreciably less waste of critical materials such as nickel and chromium.



### V2B AVAILABLE IN NEW FORMS

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QUIKUPL stainless steel elbows, tees, couplings, reducers and adapters add up to substantial savings in time, labor and materials. Installation and maintenance costs are drastically reduced. Light wall tubing can be used instead of pipe, and where tubing is already being used the costs and hazards involved in welding, soldering and flaring can be avoided. Since the only installation tool needed is an Allen wrench, Quikupl simplifies piping layout by permitting close-to-wall and compact installation.

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Valve & Fitting Division



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In hundreds of installations, the maintenance-saving design of Grinnell-Saunders Diaphragm Valves has accounted for important economies of labor and money. The only part that will in time need replacement is the diaphragm, and depending on the type of service, it may last for years. To replace it takes only a few minutes. You merely remove the four bolts holding the bonnet, leaving the body in the pipe line . . . remove the worn diaphragm, insert the new diaphragm . . . replace the bonnet and bolt it down.

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Originally perfected for air and water service, Grinnell-Saunders Diaphragm Valves are now widely specified for many other applications. They greatly reduce replacement and maintenance expenses, especially in lines where corrosion, abrasion, contamination, clogging and leakage can be costly factors. Write today for the Grinnell-Saunders Diaphragm Valve Catalog . . . and assign your next valve problem to Grinnell.

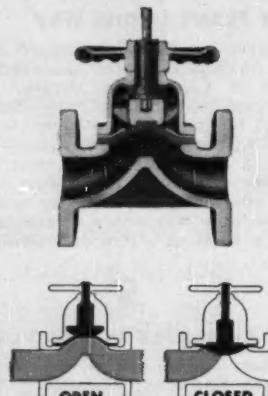
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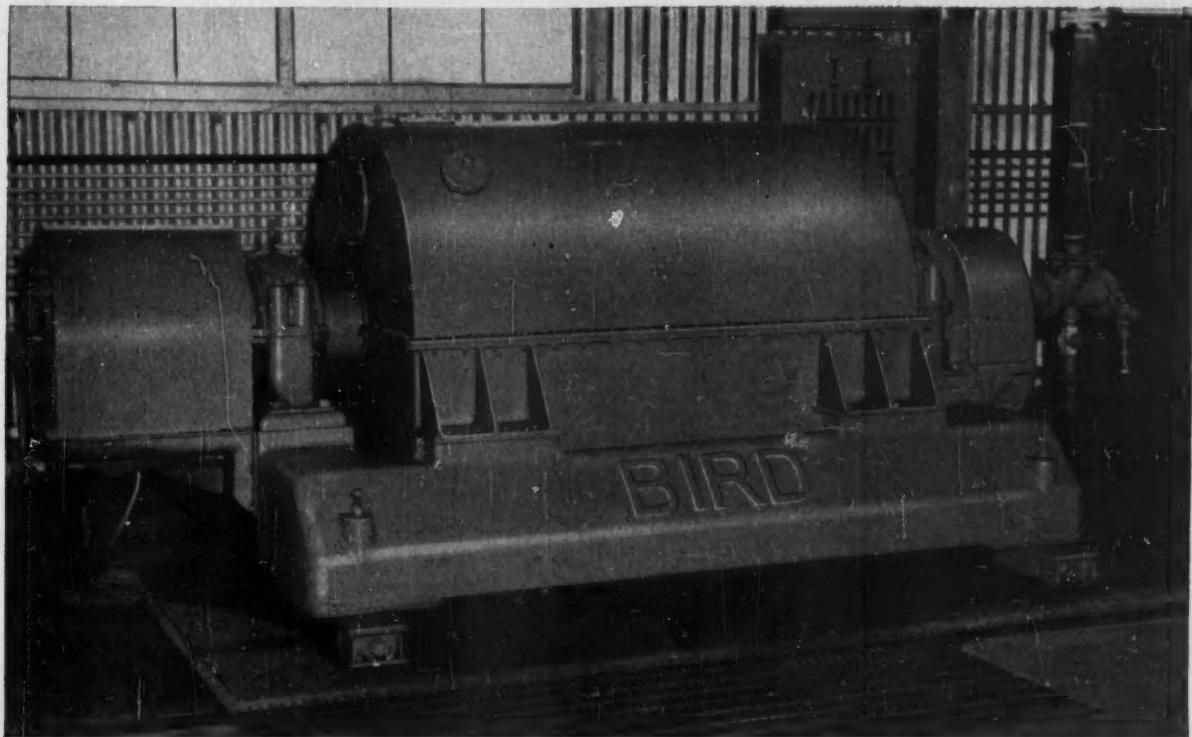
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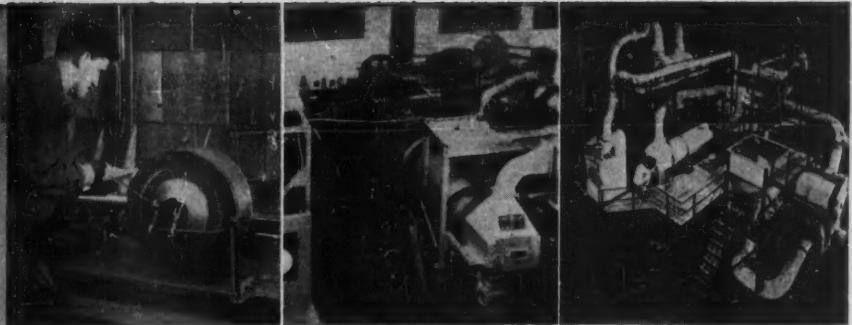
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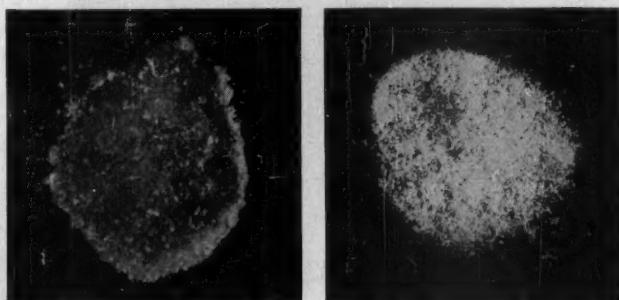
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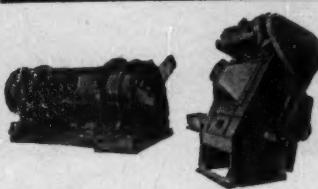
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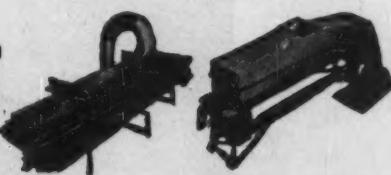
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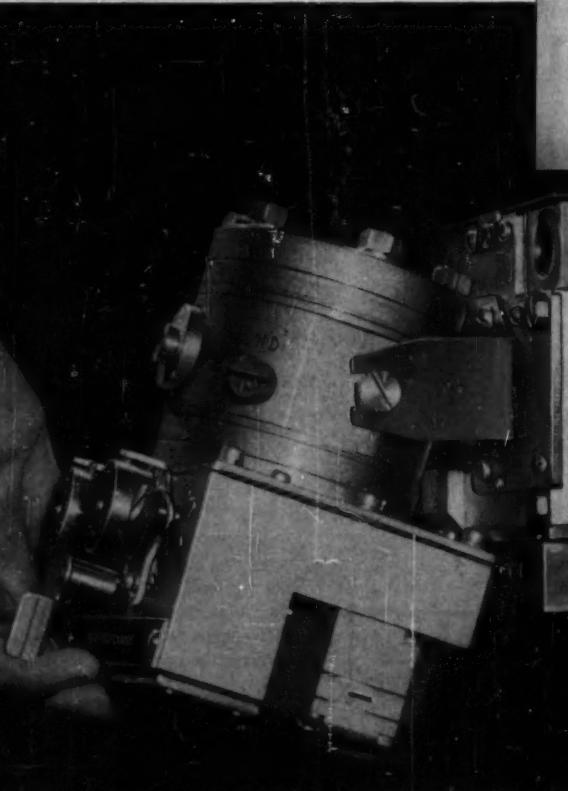
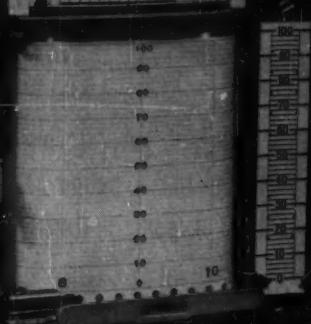


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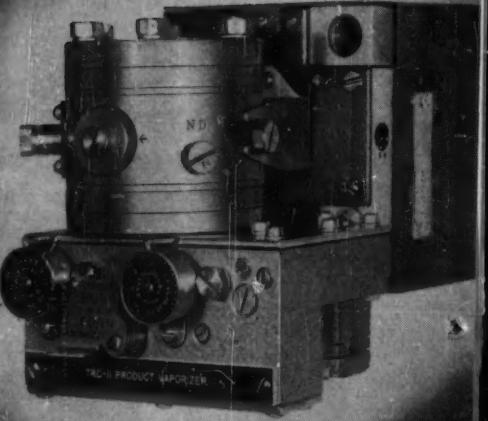
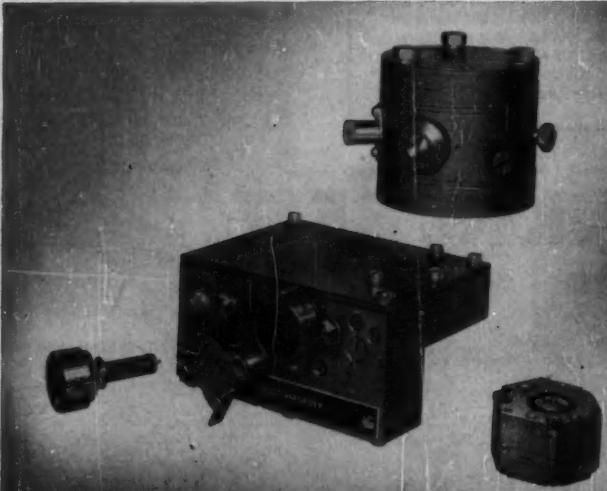
13

Horizontal scale above chart provides continuous indication of control air pressure to valve.

Quick-connect controller mounting . . . for added protection the controller is supported by a yoke when disconnected.



All adjustments are readily accessible from the rear of the controller.



Unitized construction of all major components simplifies maintenance . . . makes re-assembly foolproof.

**Today's**  
**Tel-O-Set\***  
**instruments**  
**are easiest**  
**to install**  
**... operate**  
**... service**



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BROWN INSTRUMENTS

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**Leakproof design**—with large capacity valves.

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**Versatility.** Rate action is readily added. When equipped with a manifold, the controller can be mounted remotely, either back of the panel or in the field.

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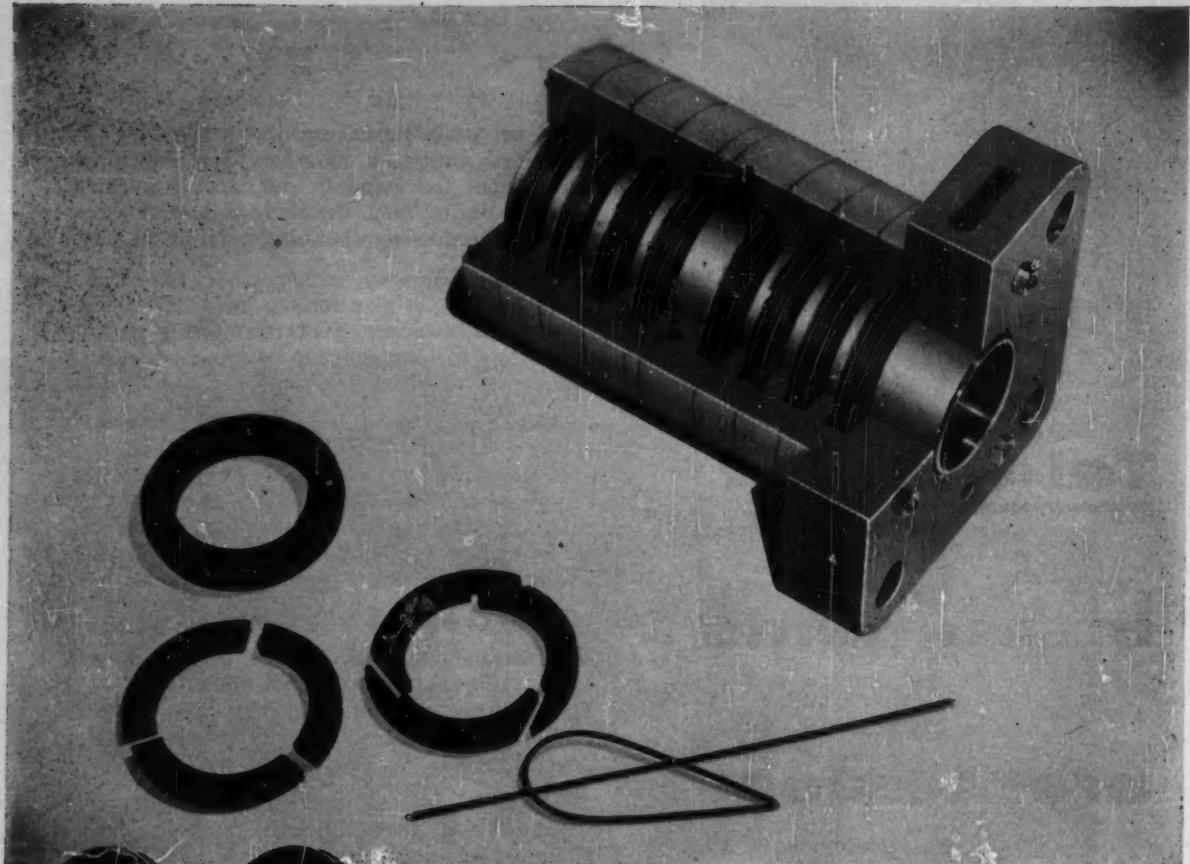
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Compare the features . . . and the operating characteristics . . . of the *Tel-O-Set* line of instruments. You'll find they represent the top in value in miniature instrumentation, that will give you the top in performance and serviceability on your process control panels. For a discussion of your specific requirements, call your nearby Honeywell sales engineer . . . he's as near to you as your phone.

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ment.

## A. R. WILFLEY & SONS, INC.

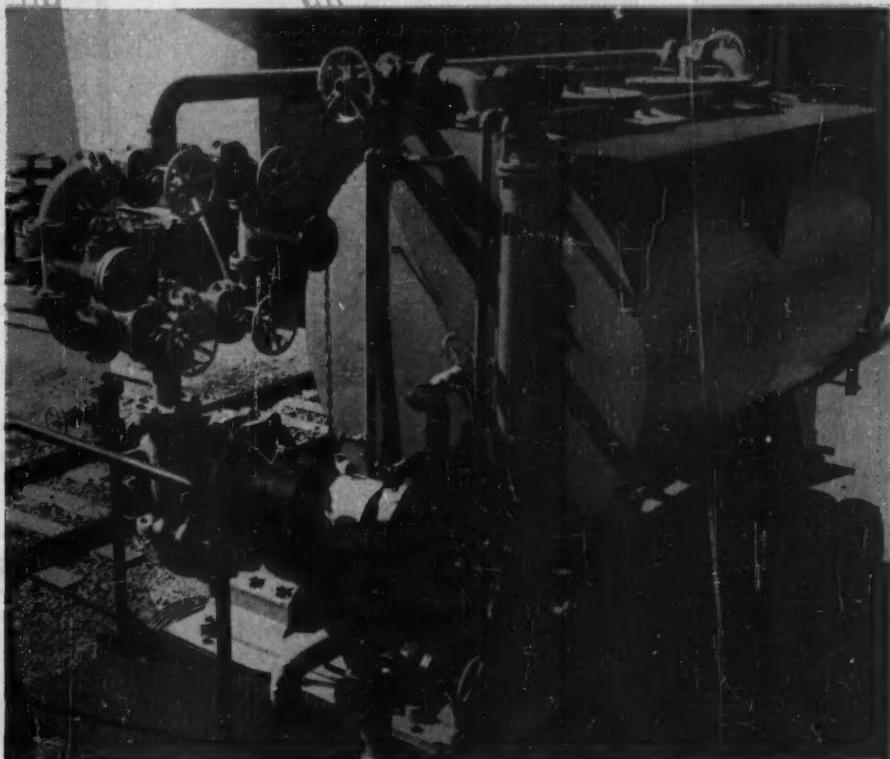
Denver, Colorado, U.S.A.

New York Office:  
1775 Broadway,  
New York City



## Cost-Saving Efficiency

A large west coast refinery uses this Wilfley Acid Pump as part of a portable chemical cleaning unit. Here, as in other modern plants throughout the world, Wilfley Pumps consistently increase production and reduce operating costs. On even the most difficult pumping jobs these dependable, highly efficient pumps deliver continuous, trouble-free performance on 'round-the-clock schedules wherever they are installed. Available with pumping parts of the machinable alloys, as well as plastic, to meet all requirements: Individual engineering on every application. Write, wire or phone for complete details.





## ALL TYPES...ANY CLASS FIRE!

Since different fire hazards require different types of fire extinguishers, PYRENE—C-O-TWO manufactures all types . . . the finest and most complete line on the market today.

When doing business with PYRENE—C-O-TWO, you receive unbiased advice on what is best for your particular fire hazards, whether class A, B or C.

Also, there is a well-rounded sales engineering organization having nation-wide representation to render top quality service wherever you're located.

Don't take unnecessary chances . . . the extensive fire protection experience of PYRENE—C-O-TWO over the years is at your disposal without obligation. Get complete facts now!

**P Y R E N E — C - O - T W O**  
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Sales and Service in the Principal Cities of United States and Canada

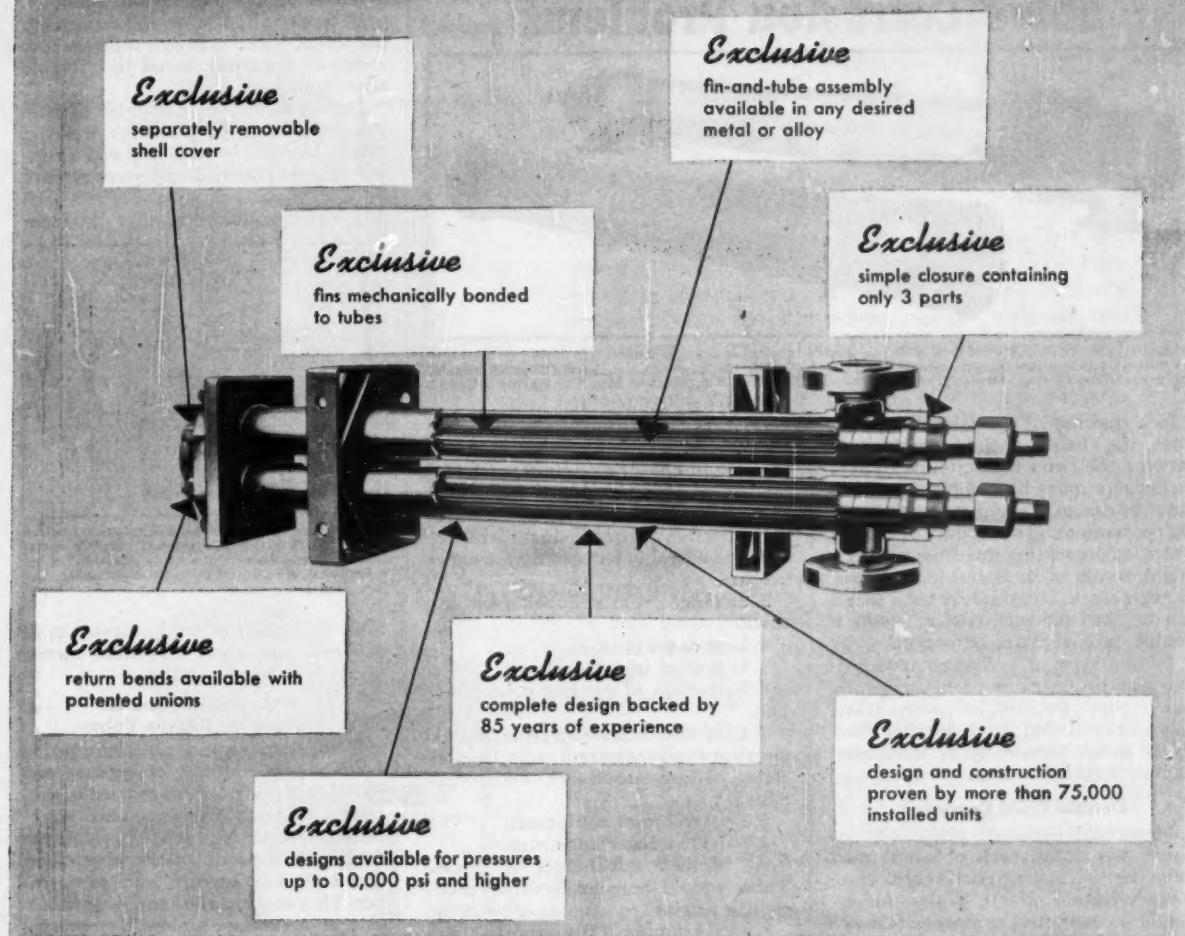
### COMPLETE FIRE PROTECTION

portable fire extinguishers . . . built-in fire detecting and fire extinguishing systems

CARBON DIOXIDE • DRY CHEMICAL • VAPORIZING LIQUID • SODA-ACID • WATER • CHEMICAL FOAM • AIR FOAM



# Exclusive WITH THIS "UNIVERSAL" HEAT EXCHANGER



These exclusive features, together with many distinctive advantages, have made the G-R Twin G-Fin Section more widely used on cooling, heating, condensing and heat exchange services than any other design of heat transfer apparatus. Write for bulletin.

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO



Twin G-Fin Section



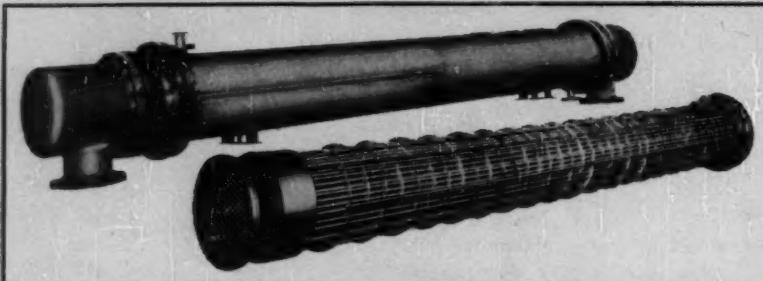
BRIDGEPORT BRASS COMPANY  
CONDENSER AND HEAT EXCHANGER TUBE EDITION

# COPPER ALLOY BULLETIN



MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

## Duplex Tubes and Double Tube Sheet Construction Solve Corrosion Problems



Bridgeport Duplex Tubes were used with this double tube sheet heat exchanger. The inside of the tubes, the outboard tube sheet and the channels are of steel while the inboard tube sheet, the shell, and the baffles are silicon bronze. Outer tube walls are copper. (Courtesy, The Whitlock Mfg. Co., Hartford, Conn.)

In a number of specialized applications, the chance of fluid interleakage between shell and tube circuits of heat exchangers must be completely eliminated by design. Examples are: preventing contamination of product or cooling water, or preventing intermixing which might result in undesirable reactions. In such cases, independent tube sheets can be used for each circuit, giving a double tube sheet construction.

In this type of exchanger, two primary corrosion causes must generally be overcome: double fluid corrosion and galvanic corrosion. Both are met effectively and economically by Bridgeport Duplex Tubes.

### Double Fluid Corrosion

Most heat exchange operations involve two fluids, each of which may have its own characteristic capacity to corrode certain metals. Water, for example, is destructive to most metals with the exception of copper and its alloys. Formaldehyde will be slightly colored by all common metals except aluminum, while sodium cyanide and ammonia corrode all common metals except steel. Thus steel tubes, which will handle ammonia on one surface, will in time be rusted through by cooling water in contact with the other surfaces.

Bridgeport Duplex Tubes combat double corrosion by offering a combination of two metals: steel, stainless steel, chrome steel, aluminum, lead, nickel, tin, etc., to the product side; and copper, aluminum brass, red brass, cupro nickel, Admiralty, aluminum bronze etc., to the cooling water side.

By drawing the proper combination of these metals to meet each set of corrosive conditions—the primary reason for the use of Duplex tubing—Bridgeport Duplex Tubes offer these advantages:

1. Effective answer to dual corrosion.
2. Considerably reduced maintenance expense.
3. Savings from reduced retubing costs.
4. Less down time.
5. Improved heat transfer.
6. Reduction of product contamination.
7. Cost economies (by replacing expensive stainless steel with Duplex Tubes of low carbon steel and copper alloy).
8. Longer life of equipment.
9. Safer, stronger construction.

All of these advantages of Duplex Tubes should be considered when designing original equipment or retubing.

A good example of Bridgeport Duplex Tube application is seen in the photo above where steel (inside) was combined with copper (outside) for the double tube sheet heat exchanger.

The heat exchanger also has a silicon bronze shell with baffles and inboard tube sheets to match the copper clad tubes, and steel outboard tube sheets and channel to match the tubes' steel lining.

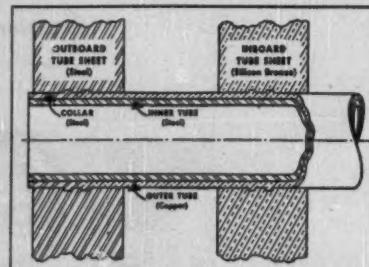
### Galvanic Corrosion

When two dissimilar metals are placed in the same solution, a small electrical current is established between them, just as in a wet-cell battery. The less noble of the two metals, say steel,

corrodes at a greater rate than the more noble metal, say copper, depending on the difference in electrical potential between the two.

A steel tube sheet may thus suffer severe galvanic corrosion when coupled with copper alloy tubes and exposed to sea water, which greatly promotes corrosion of the anode metal by galvanic stimulus.

Duplex tubes can be adapted to meet this condition as shown in the drawing. Where the tube sheet is steel and a copper tube has been drawn over steel, a portion of the copper tube is cut back and a steel collar fitted over the inner



Cross section of double tube sheet construction using Duplex Tubes. To prevent galvanic corrosion, ferrules to match outer tube sheet and inner tube metal are slipped over cut-back outer tube section and expanded.

tube. This practice can be altered to fit any combination of dissimilar metals to avoid galvanic attack.

### Wide Application of Bridgeport Duplex Tubes

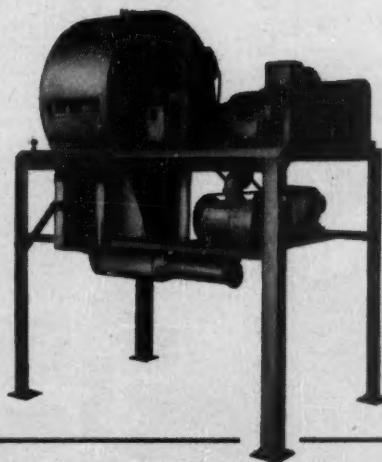
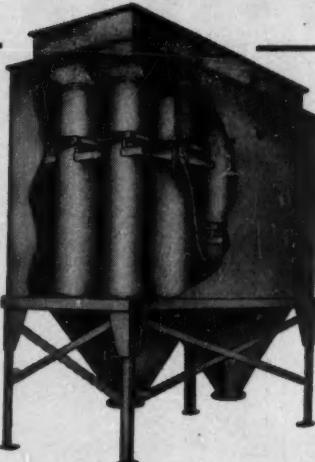
Bridgeport Duplex Tubes, supplied in various combinations of ferrous and nonferrous materials, have been in successful use for many years. Their applications include oil refining, synthetic rubber production, process operations, chemical manufacture and refrigeration. They successfully handle such products as ammonia, amines, compressed air, flue gas, formic acid, formaldehyde, hydrogen sulfide, mercury, sulfuric acid, corrosive cooling water, and many others.

As the result of many years of intensive research, Bridgeport's Corrosion Laboratory has compiled a wide background of knowledge and experience. You may have the benefit of this experience by calling on Bridgeport's Technical Service through your local Bridgeport Sales Office. We will be glad to work with you in selecting the right combination of metals for your operating conditions. Ask, too, for a copy of Bridgeport's informative technical bulletin on Duplex Tubes. (3019)

# For Multifarious Furfuraceous Triturations . . . ... DUST, THAT IS . . .

There is no longer any reason why you should sweep your dust under the rug. The two Models shown below represent the latest results of Turner & Haws' thinking and planning to provide for you an increasingly versatile and efficient line of ➤ ➤ ➤

**AEROTURN**  
Dust Collectors



Write for Bulletin on either Series 12 or Model D AEROTURN



TURNER and HAWS ENG.CO., INC.

87 Gardner Street, West Roxbury 32, Massachusetts

Representatives in principal cities

Manufactured under U.S. Patent Rights  
Other patents pending

## Series 12 AEROTURN\*

is the most advanced dust collector of its type yet produced. This is a filter collector using from 4 to 64 high-efficiency filter felt bags, 12 inches in diameter. In service automatic cleaning of the filter medium eliminates the requirement for extra filter compartments usually needed for continuous, full load operation. Reverse-air jet from automatically controlled, polished aluminum blow rings keeps filter permeability at most efficient level. Standard units in capacities from 3000 to 60,000 CFM.

## Model D AEROTURN\*

The most recent addition to our line, is a "pocket-size" dust collector combining high-efficiency filtering and reverse-air-jet filter cleaning with a compactness never before attained in any automatic filter of equal capacity. Can be supplied with an integral centrifugal preseparator for extra heavy dust concentrations. Factory assembled and test-operated units in capacities from 500 to 7200 CFM are shipped ready for operation — no assembly or costly erection required. The Model D is something really new in dust collectors.

TURNER & HAWS ENGINEERING CO., INC.

87 Gardner Street,  
West Roxbury 32, Massachusetts

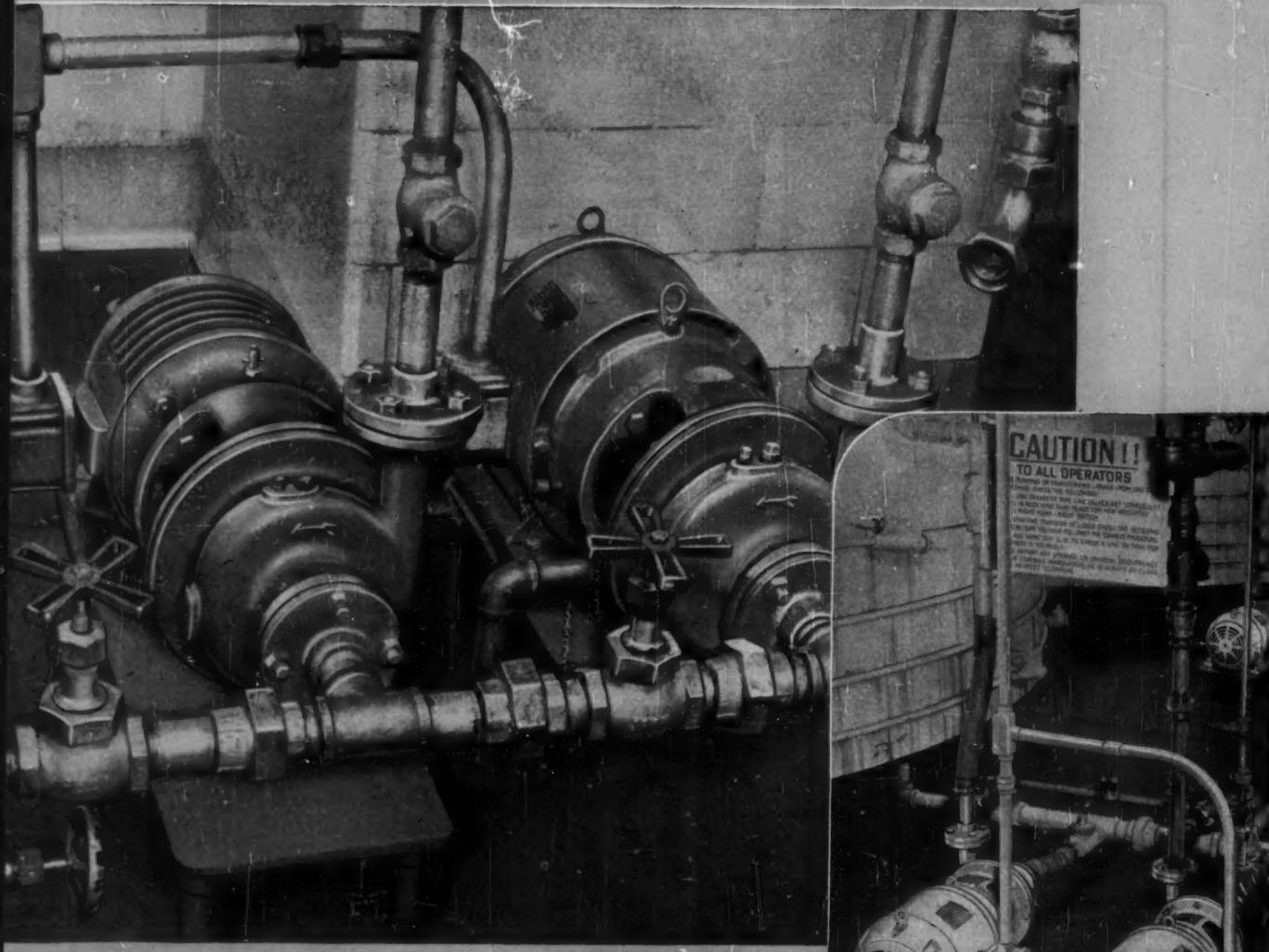
Please send me information on  
Series 12  Model D

Name.....

Company.....

Address.....

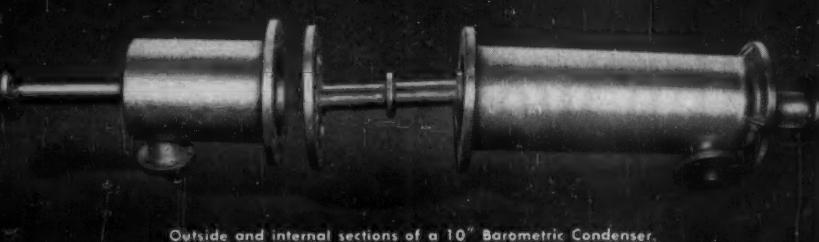
# Seven reasons why Kraft Foods Co. uses...



Ampco Centrifugal Pumps, made of Iium "G", pumping vinegar to automatic measuring devices in the Mayonnaise and Miracle Whip Processing Dept., Kraft Foods Co., Chicago, Illinois.

Ampco Pumps are available in most workable alloys. When made from corrosion- and wear-resistant Ampco Metal, they give you all the advantages of a special pump at standard pump prices.

Ampco Pumps handling vinegar from tank cars to storage, Kraft Foods Co., Chicago.



# AMPCO<sup>\*</sup> CENTRIFUGAL PUMPS

- 1 Good corrosion-resistance
- 2 Low capital investment
- 3 No metal-to-metal contact
- 4 High efficiency
- 5 Constant rate of flow
- 6 Durametallic seals that resist wear — are easy to replace
- 7 Small space requirements

KRAFT uses corrosion-resistant Ampco Centrifugal Pumps to handle the vinegar used in the production of its mayonnaise and salad dressing. These pumps give a dependable flow rate . . . freedom from contamination . . . greater dependability . . . less downtime.

Moreover, Ampco Pumps are used throughout industry for difficult liquid-handling problems. They represent pump design at its best — both hydraulic and mechanical. They save power — have wide performance range, good characteristics, high efficiencies (up to 85%). They save money — you get a special pump at a standard pump price. They're built of Ampco Metal — the special alloys that make good where other metals fail. That's why they're unusually resistant to wear, corrosion, erosion, cavitation-pitting, and deformation. That's why you get a pump that will successfully handle abrasive solids in suspension, or viscous liquids.

Best of all, Ampco Pumps are production-built, competitively-priced in a wide range of sizes. You can get them not only in Ampco Metal, but also in Illium "G" or other workable alloys to meet the requirements of unusual jobs.

Put these standard units to work for you — give them the tough jobs that formerly required high-priced special pumps. Take advantage of low-cost, long-life, headache-free pumping. Check with your nearby Ampco distributor or write us for the solution to your difficult fluid-handling problems.

\*Reg. U. S. Pat. Off.

Attach this coupon to a postcard and mail today. →

Illium "G" is the registered trademark of the Illium Corporation

**Ampco Metal, Inc.**

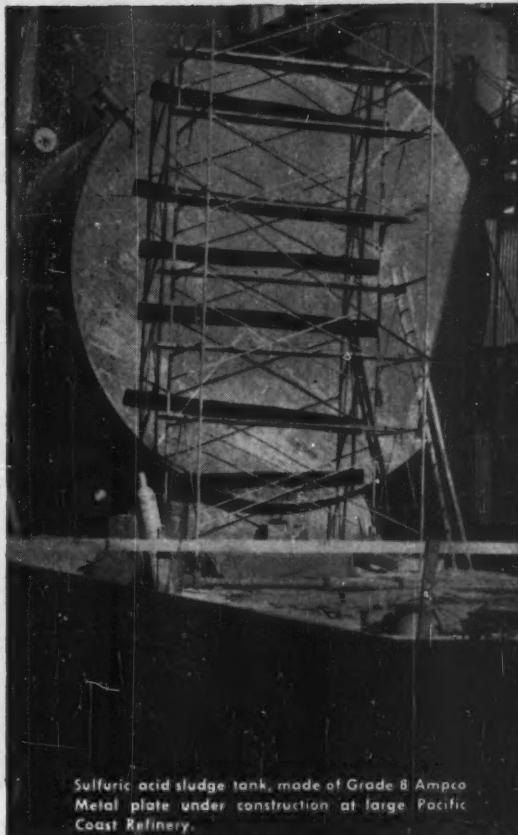
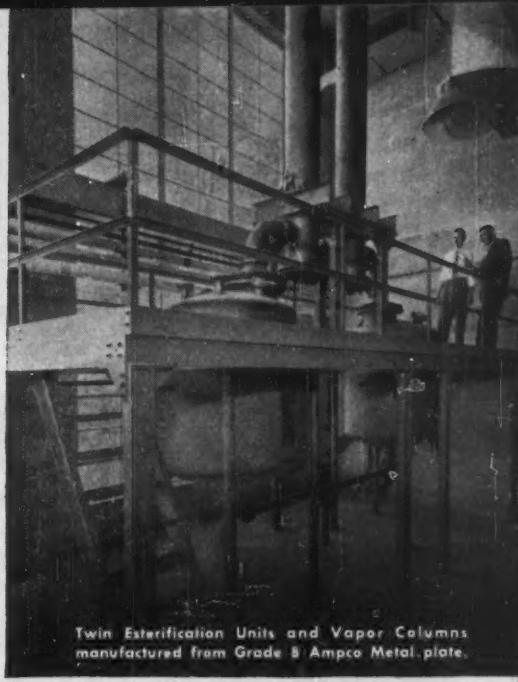
MILWAUKEE 46, WISCONSIN

West Coast Plant  
BURBANK, CALIFORNIA



*mettle*

LET AMPCO PROVE ITS-METAL



AMPCO METALS, INC., Dept. CE-1, Milwaukee 46, Wisconsin

I'm interested in Ampco Centrifugal Pumps. Send me bulletin No. P-3a.

I'd like to know more about Ampco Metal for use in process industries. Send me more information.

Name.....Title.....

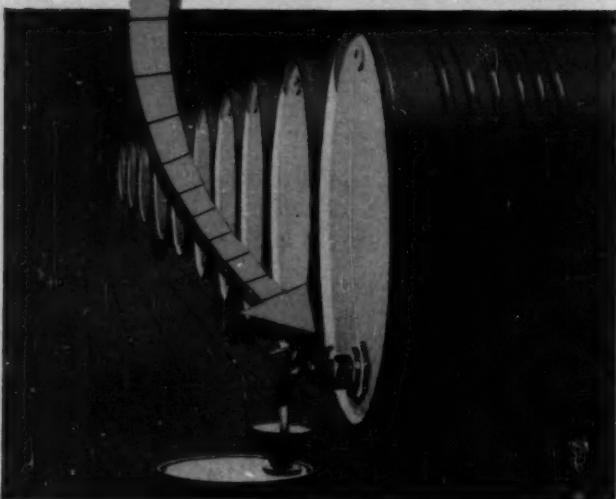
Company.....

Company Address.....

City.....(.....) State.....

PR-14

# Do you go all the way with quality control?



## UNITED STATES STEEL PRODUCTS DIVISION

UNITED STATES STEEL CORPORATION  
30 ROCKEFELLER PLAZA, NEW YORK 20, N.Y.

Los Angeles and Alameda, Calif. • Port Arthur, Texas • Chicago, Ill.  
New Orleans, La. • Sharon, Pa.

## USS STEEL DRUMS

UNITED STATES STEEL

AFTER so carefully maintaining the highest possible standards of quality during the manufacture of your products, it will pay you to protect that product quality during *shipping*, too. USS scale-free, rust-inhibited Drums will *keep* your products clean and uncontaminated. There is no grease, dirt or scale in a USS Steel Drum to affect its contents. A surface absolutely clean—physically and chemically—is covered with a tightly adherent, truly effective rust-inhibiting coating.

This means that USS Steel Drums are better for you . . . better for your customers. It means that you now have a dependable means of guarding the quality of your products *after* they leave your plant . . . that you can now take advantage of the great strength and durability of steel drums, and at the same time, be sure of contamination-free shipment and storage of products.

United States Steel Products fabricates stainless, galvanized, tinned, painted and decorated drums and pails. Furnished in capacities from  $2\frac{1}{2}$  to 110 gallons, with a variety of fittings and openings to fit your particular requirements.

### WRITE FOR FREE BROCHURE

For additional information on this quality steel drum write to us at New York for this full-color brochure, "USS Drums—100% Scale-free and Rust-inhibited."



"It's Better to Ship in Steel"

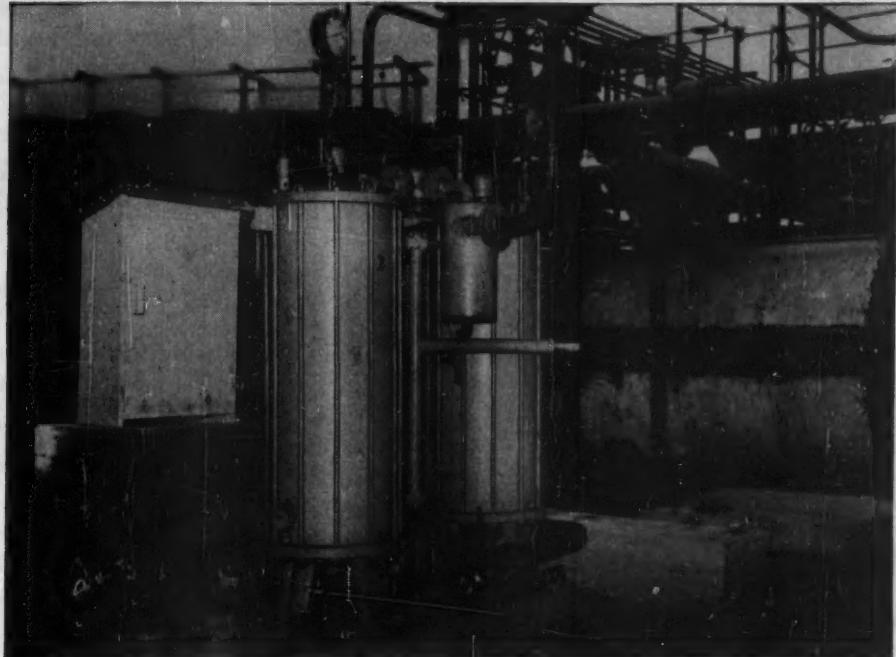


**In England, too, they say**

**"If wet gas corrodes,**

**DRY it with a Lectrodryer"**

This British-made Lectrodryer<sup>\*</sup> by Birlec Ltd. is DRYing wet gas in a heavy chemicals plant.



Moisture in a gas—or in air and organic liquids—can cause serious damage. Unless that moisture can be eliminated as a hazard, expensive corrosion-resistant metals must be employed in processing equipment. Lectrodryers remove that moisture, thereby permitting cheaper construction and first costs to be held down.

Unwanted moisture in materials entering into a process is usually an unpredictable variable. It causes delicate reactions to go wrong, running up losses while also injuring product quality. Lectrodryers

hold that variable, moisture, to a fixed minimum, helping to keep processes on the straight and narrow path.

DRYing at low or high pressures, in small or tremendous volumes, to dew-points below minus 100° F.—there are standard Lectrodryers for all these services. Our engineers are expert in applying them to solve your DRYing problems.

For this help, or for "Because Moisture Isn't Pink" describing Lectrodryer installations, write Pittsburgh Lectrodryer Corp., 303 32nd St., Pittsburgh 30, Pa.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.  
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.  
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY  
WITH ACTIVATED ALUMINAS

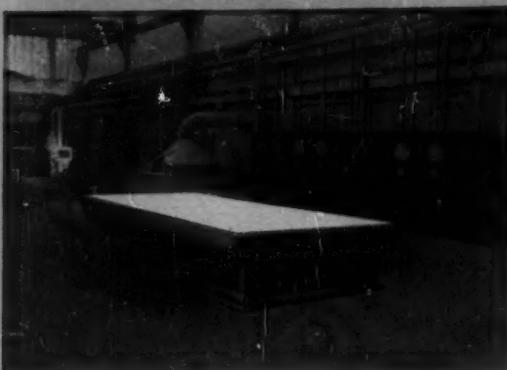
**LECTRODRYER**

\* REGISTERED TRADEMARK U.S. PAT. OFF.

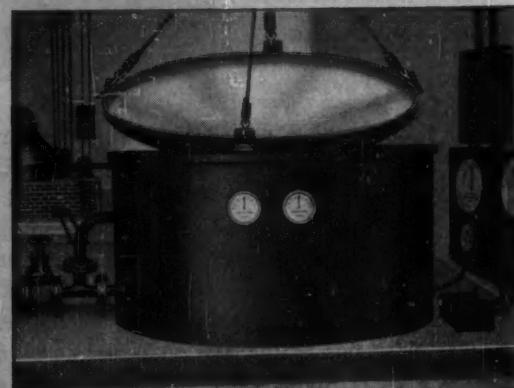
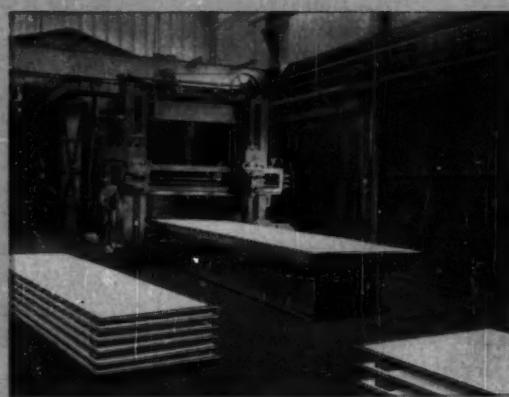
**KELLEY**  
**Pioneers in  
 HOMOGENEOUS LEAD BONDING**  
*First Again with a "NEW MECHANICAL" Bonding Process*

\*Our newly developed "mechanical" process for applying Homogeneous Lead Bondings affords you a considerable saving in both delivery time and cost over the slower "hand-burning" method.

We suggest that you pay a visit to our plant and view this newly developed "Mechanical" cost-saving lead bonding process. Our Engineers are available for consultation without obligation. Your inquiries are solicited.



Homogeneous Lead Bondings are applied to any thickness of shell plates in the flat before shaping to your specifications. Plates as large as 10'-0" x 20'-0" are easily handled on our new unit, thus eliminating many unnecessary weld seams. Outlets and connections are Homogeneously Bonded regardless of size.



Dished Heads of all types and various irregular shaped pieces of equipment are Homogeneously Lead Bonded in our Special "MECHANICAL" Unit. Here again, considerable saving in time and cost is effected over the general method.

**KELLEY** Custom-Built for the Processing Industries

TANKS · LEAD COILS · LEAD & LEAD LININGS · VALVES  
 SHEET LEAD LININGS · CASTINGS & FITTINGS



**O. G. KELLEY & CO.**  
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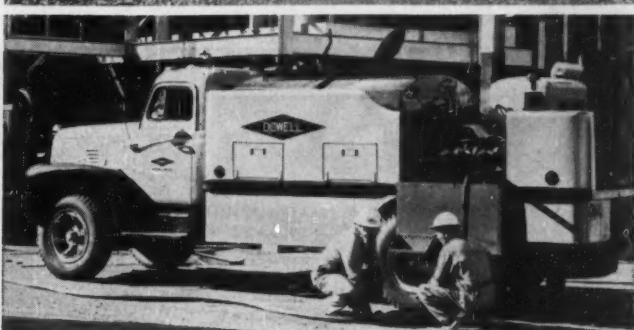
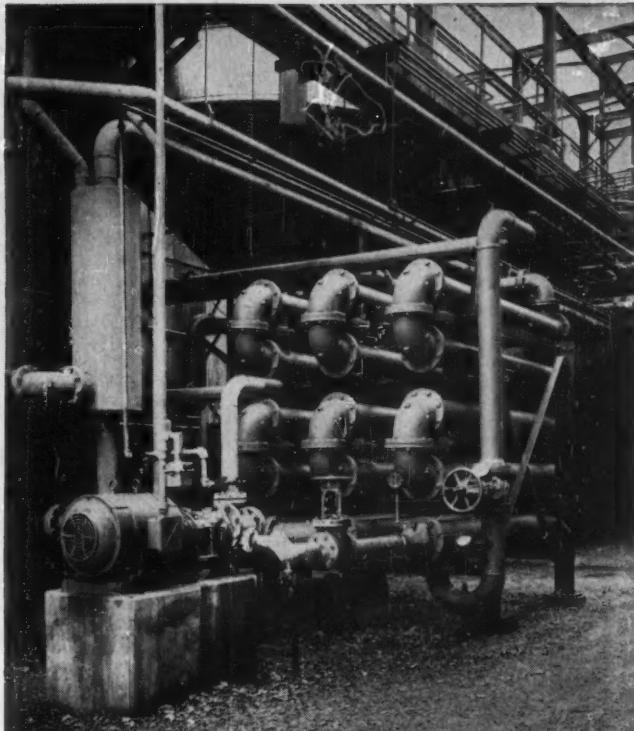
Experienced engineers are at your service day and night. They diagnose the trouble, prescribe and administer the cure for maintenance cleaning problems.

# NO SHUTDOWN FOR CLEANING

Scale removed chemically from caustic tanks and coolers while units continued to operate. Full capacity restored.

Time and time again Dowell Service has proved that industrial equipment—heat transfer units, boilers, tanks—can be cleaned quickly and effectively with chemicals. Take this case for example. Dowell was called in to clean some caustic cooling tanks and coils for a large chemical company. A reduction in cooling capacity and an increase in input pressure indicated the equipment had become clogged with scale. Sea water had been run through these coils as the cooling agent, leaving iron and chloride deposits.

Dowell engineers pumped specially prepared liquid



Dowell's specially equipped trucks provide all the necessary equipment for modern chemical cleaning operations. Solvents are applied according to the technique demanded by the job: filling, spraying, jetting, cascading or vaporizing.

solvents into the units through regular connections—without dismantling. No scaffolding was necessary. Caustic production was continued during the job. Operations were curtailed only slightly. The tanks and coils were restored to full cooling capacity in less than 18 hours.

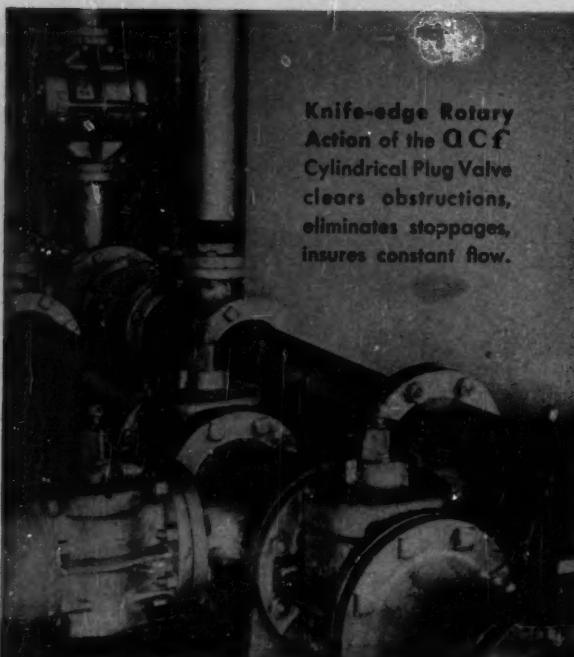
Whatever your cleaning problem—piping systems or process equipment—call a Dowell engineer. He will be glad to work with you—no obligation. For consultation, contact your nearest Dowell office or write to DOWELL INCORPORATED, Tulsa 1, Oklahoma, Dept. A-33.

**DOWELL SERVICE**

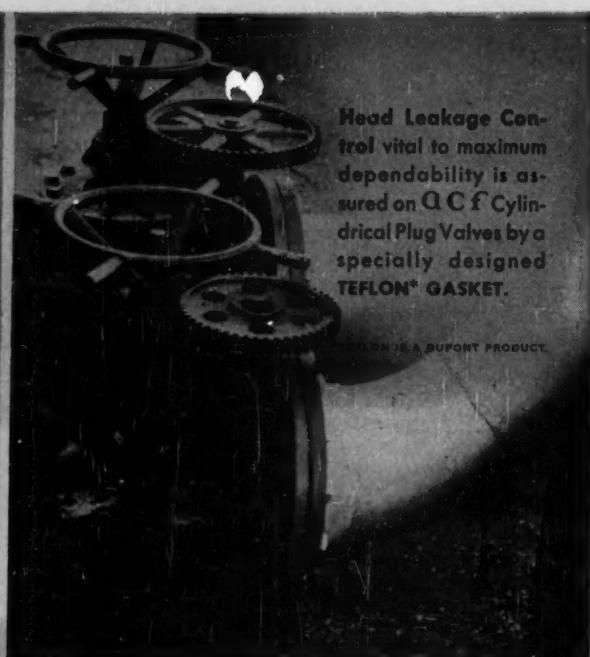
chemical cleaning service for industry



A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

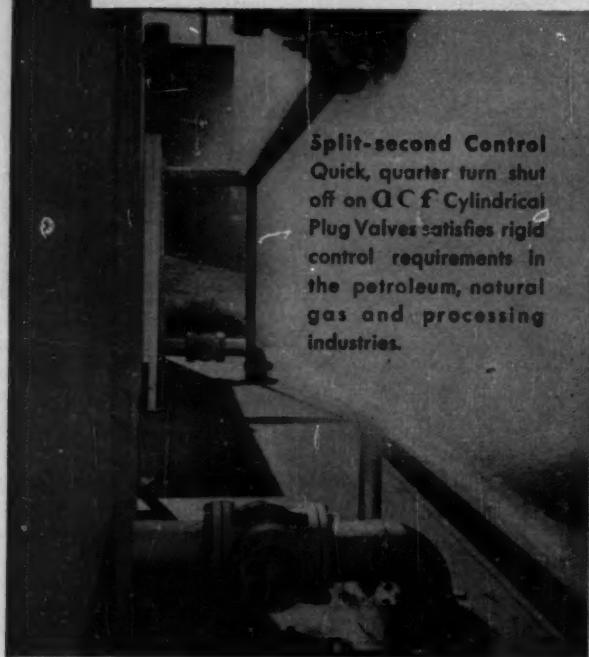


**Knife-edge Rotary Action** of the Q C F Cylindrical Plug Valve clears obstructions, eliminates stoppages, insures constant flow.

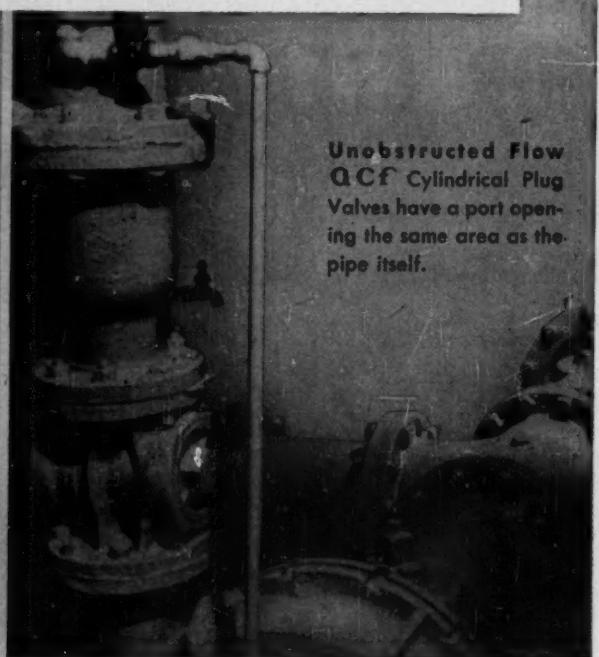


Head Leakage Control vital to maximum dependability is assured on Q C F Cylindrical Plug Valves by a specially designed TEFLO<sup>N</sup> GASKET.

## QUALITY THAT PAYS OFF



**Split-second Control**  
Quick, quarter turn shut off on Q C F Cylindrical Plug Valves satisfies rigid control requirements in the petroleum, natural gas and processing industries.



**Unobstructed Flow**  
Q C F Cylindrical Plug Valves have a port opening the same area as the pipe itself.

Rectangular Port and Full Round Port

**aCf**

Representatives in 50 Principal Cities



**PLUG VALVES**

Write For Descriptive Catalog 5 to Dept. 1-C,  
Q C F Industries, Incorporated, Valve Division,  
1501 E. Ferry Avenue, Detroit 11, Michigan.

# High-Purity Fused Alumina Grains...

## What Can They Do For You?

**F**USED alumina, with its inherent properties of hardness, chemical stability and high density, is one of the most widely used electrochemically refined materials. It is produced in many forms. One of these, Norton 38 ALUNDUM\* grain has proved successful for many applications demanding high purity. Electrically fused from Bayer-processed alumina, this white grain is shown by typical chemical analysis to be 99.49% pure  $\text{Al}_2\text{O}_3$ . It is insoluble in common solvents and extremely resistant to reduction. It is an amphoteric refractory and has high dielectric strength. Other characteristics include:

Melting point — about 3600°F.  
Specific gravity — 3.94  
Crystal structure — hexagonal system  
(rhombohedral division)  
Hardness — 9.0 Mohs' scale  
Index of refraction — 1.76 mean

Typical uses of 38 ALUNDUM grain are: pure oxides and sintered refractories, refractory cements, catalyst supports, heat exchange pebbles, wear-resistant parts, laboratory ware.

Other types of Norton fused alumina with unique combinations of properties which make them highly suitable for special requirements include:

### 38500 and 38900 AWIF ALUNDUM Grains

In these further refinements of 38 ALUNDUM grain, the terminal designations 500 and 900 indicate particle sizes. In the 38500 grain, average and maximum particle sizes are 19.5 microns and 50 microns, respectively; in the 38900 grain average and maximum particle sizes are 7.5 microns and 30 microns, respectively. Particle sizes are consistently very uniform. AWIF signifies "acid-washed and iron-free."

Although these grains have the same physical properties as 38 ALUNDUM grain, their special processing to remove objectionable elements results in unusually

high purity. A typical chemical analysis reveals:

$\text{Al}_2\text{O}_3$  — 99.86% •  $\text{Fe}_2\text{O}_3$  — .01 to .05%  
 $\text{SiO}_2$  — .01 to .05% •  $\text{Na}_2\text{O}$  — .01 to .08%  
C — <.01% • pH — >4.1

Very good electrical resistance, high heat conductivity and inertness are further advantages of 38500 and 38900 ALUNDUM grains for applications in both the electrical and chemical fields. In addition to their use in electronic tubes, as illustrated, other possible uses include the manufacture of ceramic pieces, particularly electronic components where the inherent qualities of this extremely pure grain are of great value.

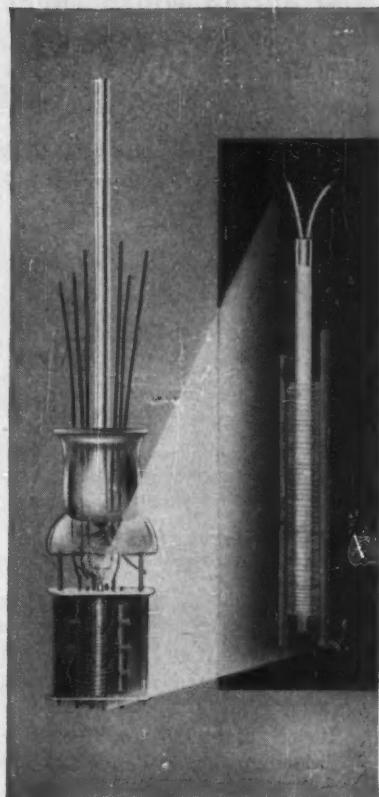
### Other Norton Electrochemically Refined Materials

We made ALUNDUM grains the subject of this message. But we could just as well have chosen any of the long list of well known Norton electric furnace materials — CRYSTOLON\* silicon carbide, MAGNORITE\* magnesium oxide, NORBIDE\* boron carbide, FUSED STABILIZED ZIRCONIA, and many others, including a number still undergoing research and development.

These high-melting materials which have varied applications in many fields, are also the basic ingredients of the famous Norton Refractory Rx's — refractories engineered and prescribed for the widest range of uses.

### For Your Own Applications or Developments

Norton Company not only supplies these materials in their crude form, but has extensive facilities for processing and fabricating — and is ready to work with you in engineering materials to your particular requirements. A new booklet "Norton Refractory Grain Electrochemically Refined" contains detailed information on these interesting materials. NORTON COMPANY, 500 New Bond Street, Worcester 6, Mass.



IN ELECTRONIC TUBES Norton 38500 or 38900 ALUNDUM fused alumina grain is used to coat heater filament tubes (shown enlarged). The grain is put in suspension and the filament is drag coated, spray coated or electrically deposited (cataphoresis).

**NORTON**  
REFRACTORIES

Engineered... Rx... Prescribed

Making better products...  
to make other products better

\*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

# caustic soda-

## which strength should you buy?

**Here are the facts to help  
you decide which saves  
you more—50% or 73%**

Can you save by switching from 50 to 73% liquid caustic? Your answer will depend on:

1. Your caustic soda freight rate.
2. Your facilities for handling caustic.
3. The amount of caustic you use.

**Advantages of 73% liquid**

1. With 73%, there is a substantial saving in freight charges. 63% less water is shipped per unit weight of dry caustic soda.
2. You will place fewer orders. This cuts down on your billing work.

**Disadvantages of 73% liquid**

1. It is priced \$2.00 more per ton (dry basis) than 50% because of higher manufacturing costs.
2. If you store it as 73% liquid, you will need heated, nickel-clad steel storage tanks.
3. If you dilute 73% to 50% while unloading, you will need a cooler and other equipment. This represents a considerable investment which can be reduced if you have

suitable equipment already on hand.

**Use this table to see if you  
can save with 73%**

Use the table at right to find your approximate saving on freight charges with 73% liquid caustic. The table balances two cost factors . . . lower freight charges and the higher initial price of 73% liquid caustic.

To estimate your yearly savings, multiply the figure in the right-hand column which applies to you by your annual consumption in tons (dry basis).

From these savings you will have to deduct the cost of equipment for diluting to 50% while unloading.

| <i>Freight rate per<br/>hundred weight<br/>in cents<br/>(including taxes)</i> | <i>Net savings per<br/>ton (dry basis)<br/>in dollars</i> |
|---|---|
| 5   | minus 1.40  |
| 10  | minus .80   |
| 15  | minus .10   |
| 16  | 0   |
| 20  | .60   |
| 25  | 1.20  |
| 30  | 1.80  |
| 35  | 2.40  |
| 40  | 3.00  |
| 45  | 3.70  |

### HERE'S HELP—WITHOUT COST

You gain much by choosing the *right* strength for your conditions. In coming to a decision, why not give yourself the advantage of unbiased expert technical help? A call to your nearest Hooker sales office puts at your disposal, without obligation, the experience gained in 50 years of supplying caustic soda to industry.

Your Hooker technical service man can show you what equipment you need for converting,

and help you figure your exact savings. Why not phone or write him today at the nearest Hooker office?

\* \* \*

"CAUSTIC SODA BUYER'S GUIDE" is the title of a new pocket-size booklet we will be glad to send you. Contains helpful facts on the economics of 50% and 73% solutions; other forms of caustic soda; capacities of tank cars and other containers; useful shipping information. Write for a copy.

**HOOKE  
CHEMICALS**

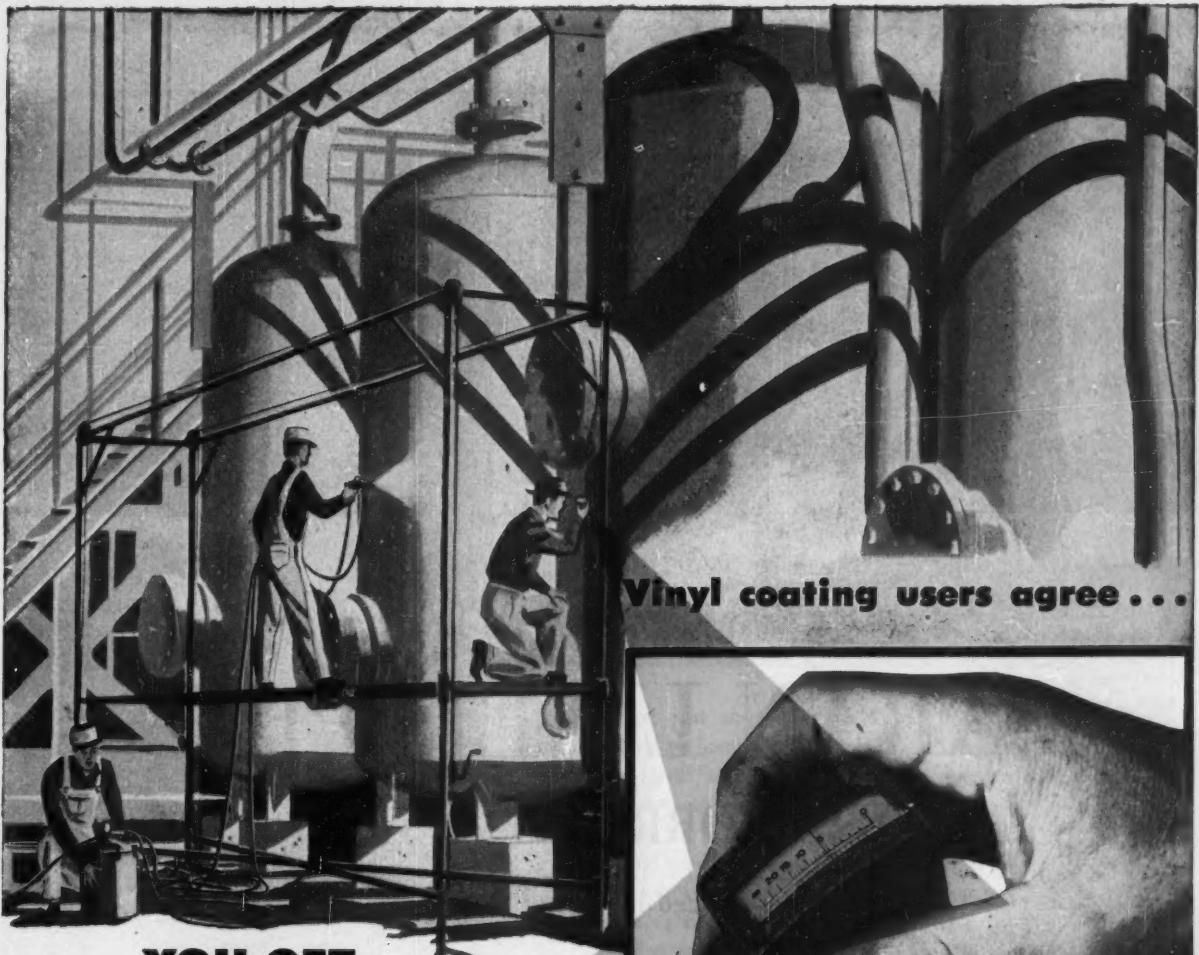
4-1094

1905—Half a Century of Chemicals from the Salt of the Earth—1955

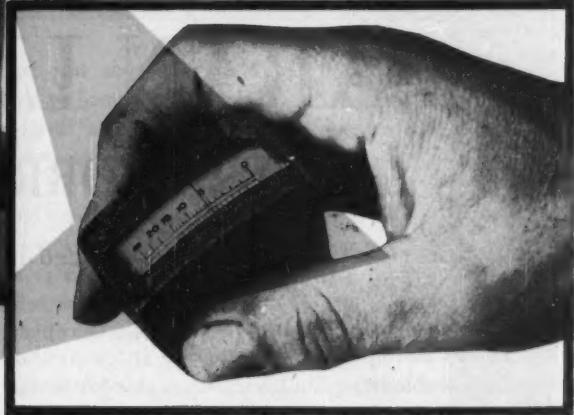
**HOOKER ELECTROCHEMICAL COMPANY**

5 FORTY-SEVENTH ST., NIAGARA FALLS, N.Y.

NIAGARA FALLS • TACOMA • MONTAGUE, MICH. • NEW YORK • CHICAGO • LOS ANGELES



**Vinyl coating users agree . . .**



## **YOU GET MORE MILS PER GALLON WITH AMERCOAT 33**

Amercoat's higher solids content gives you a thicker, heavier coating—more mils for every gallon applied.

### **THIS MEANS YOU SAVE MONEY TWO WAYS ON MAINTENANCE PAINTING**

**Lower Material Cost.** You save on material because it takes fewer coats of AMERCOAT 33 to build the required film thickness.

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In addition to more mil thickness per gallon, you get more protection per gallon. AMERCOAT 33 is formulated specifically for maximum chemical resistance and for severe weathering conditions. In major industries from coast to coast — chemical, petroleum, pulp and paper, food, and many others — maintenance engineers look to AMERCOAT 33 for low cost, long lasting protection for all types of steel or concrete structures.

Amercoat pioneered the development of protective coatings especially designed for severe corrosion problems. Today it is the only organization that offers you... a complete line of corrosion resistant coatings...nationwide distribution... trained technical men to give you on-the-job assistance throughout the United States and Canada.

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South Gate, California  
CHICAGO, ILL. • NEWARK, N.J. • JACKSONVILLE, FLA. • HOUSTON, TEX.



Write today for  
the AMERCOAT 33  
Technical Bulletin  
which gives  
a complete  
description of  
the coating's  
chemical and  
physical properties.

Dow



## You Can See Why SARAN LINED PIPE CUTS CORROSION COSTS

Corrosion resistant Saran Pipe swaged into steel is your answer to downtime losses.

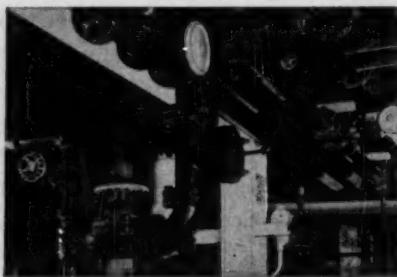
Saran lined pipe, fittings and valves are built to convey acids, alkalies and other corrosive liquids at low over-all costs. The durable inner lining eliminates shutdowns due to corrosion and forms snug, tight-fitting joints that prevent leakage.

Saran lined pipes, fittings, and valves are easily and inexpensively installed. They are cut and threaded in the field with any standard pipe fitter's tools. Because of saran lined pipe's rigidity, even long spans require a minimum of support.

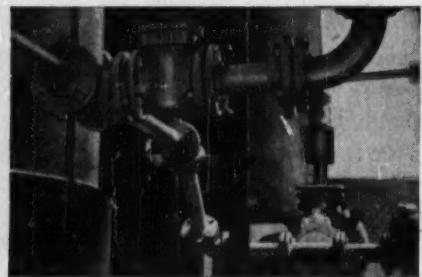
If your operation requires the conveying of corrosive liquids, and if downtime losses are troubling you, investigate saran lined pipe, fittings, and valves today. For further information, contact the Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale 20, Mich. Dept. 526A

**RELATED SARAN PRODUCTS**—Saran rubber tank lining • Saran rubber molding stock • Saran tubing and fittings • Saran pipe and fittings.

SOME OF THE MANY  
INSTALLATIONS USING  
**SARAN LINED**  
STEEL PIPE



A large chemical company uses this installation to convey demineralized water. It has a perfect record of keeping the water free of contamination for five years!



Saran lined pipe used for conveying hydrochloric acid at temperatures from 20° to 90°C., has had no unscheduled interruptions due to corrosion for over two years!

*you can depend on DOW PLASTICS*

Dow

## *Which of these is your pumping problem?*



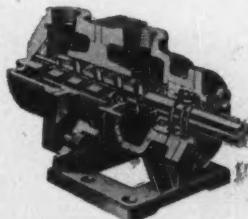
Name just about any fluid you consider "hard to handle" and we will show you a De Laval pump that will do the job efficiently and at low cost.

De Laval IMO and CPO pumps have solved problems on a wide range of products—hot or cold, acidic or alkaline, viscous or corrosive, clear or filled with suspended solids. IMO and CPO models are available for early delivery.

Your De Laval representative is an experienced application engineer. Consult him on your pumping problems or write today for literature.

### DE LAVAL IMO PUMPS

capacities to  
750 gpm  
pressures to  
1500 psig



DE LAVAL  
CPO PUMPS  
capacities to  
2000 gpm  
heads to  
200 feet



**DE LAVAL Pumps**

DE LAVAL STEAM TURBINE COMPANY  
803 Nottingham Way, Trenton 2, New Jersey

GL 200



## New insulating method saves hours and hours on tanks and towers!

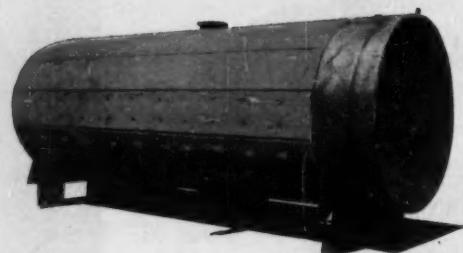
Imagine wrapping tanks and towers with a lightweight, flexible insulation that fits any curved or flat surface—instead of laboriously building up rigid insulating materials, block by block. Imagine further that the new method requires almost no cutting or fitting time, no expansion joints or welded rings, no pointing up.

Then imagine how much time and money this method would save you—and at once you'll see the advantages of using ULTRALITE long glass fiber insulation blankets. It is easily applied and easily finished with weather-proofing materials. Savings are truly worthwhile, as proved time and again on oil storage tanks, asphalt truck tanks, fractionating columns, reboilers, blending tanks, etc. (And for hot or cold piping, savings are just as substantial when you use our new G-B Snap-On pipe insulation—a one-piece molded pipe insulation of fine glass fibers.)

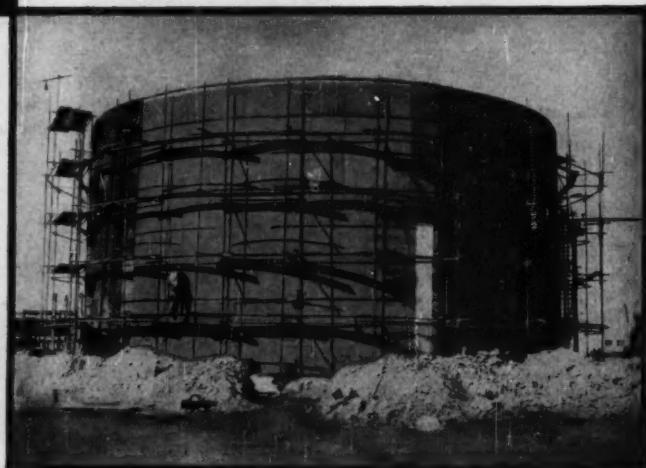
No damage from water . . . no heat loss from "fluing action" . . . no problems when repairs are necessary—for Ultralite is resilient, reusable, won't absorb moisture.

# ULTRALITE

*the long glass fiber insulation*



Write today for  
"How-To-Do-It" specifications  
and name of your nearest Ultralite distributor



**GUSTIN-BACON MANUFACTURING CO.**

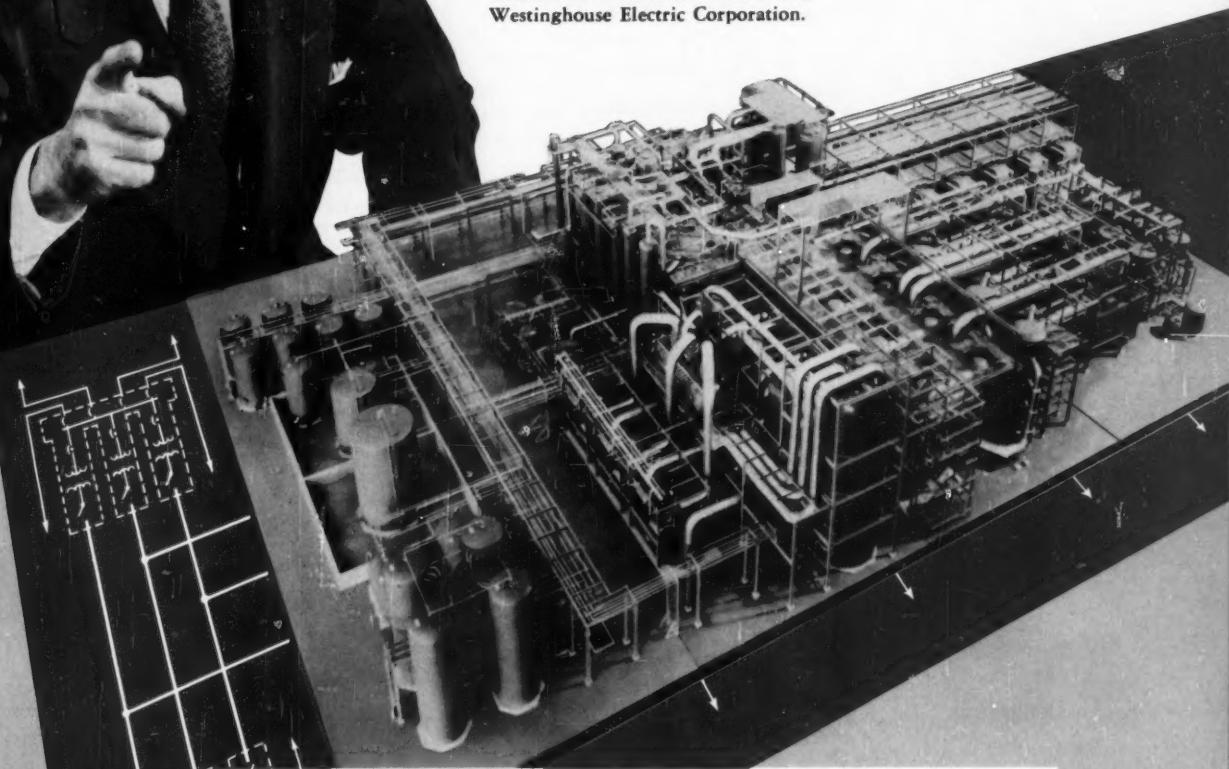
252 W. 10th ST., KANSAS CITY, MO.

New York • Chicago • Philadelphia • San Francisco • Los Angeles  
Houston • Tulsa • Dallas • Detroit • St. Louis



# Is your electrical system as good as your process?

Mr. J. Z. Linsenmeyer, Engineering Manager,  
Chemical and Petroleum Industries,  
Westinghouse Electric Corporation.



## THESE ARE IMPORTANT TO YOUR PROCESS

Page in this  
Insert

|  |      |
|--|------|
| Examples of successful systems . . . . .                                   | 2, 3 |
| What it means to plan a system . . . . .                                   | 3    |
| How you can meet the needs of constant throughput:                         |      |
| Transformers . . . . .   | 4, 7 |
| Switchgear . . . . .   | 5, 6 |
| How to get process flexibility:  |      |
| Power Centers . . . . .  | 5, 7 |
| Bus Duct . . . . .   | 5, 7 |
| Capacitors . . . . .   | 4, 8 |
| Westinghouse can help you line up<br>primary and secondary power . . . . . | 8    |

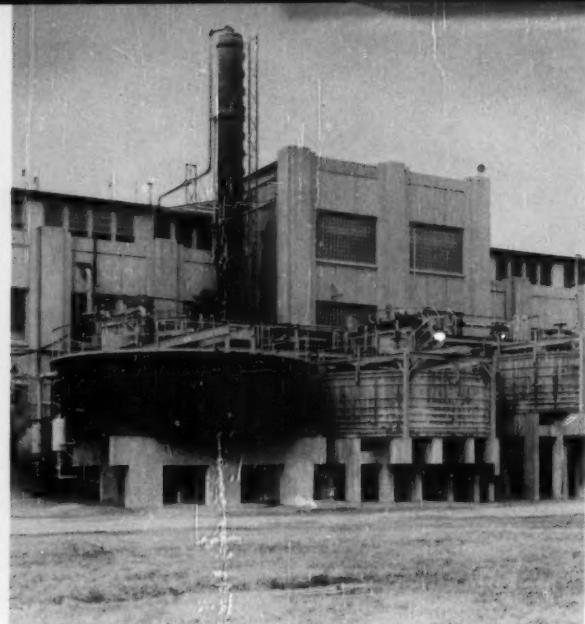
YOU CAN BE SURE... IF IT'S

# Westinghouse





This plant, producing chlorine, caustic soda and other chemicals, is served from front to back door with a complete Westinghouse power generation, distribution and utilization system. A secondary distribution system of the selective radial type protects this operation against thousand-dollar-a-minute down time.



American Cyanamid engineers and Westinghouse worked out a system that will pay dividends for a long time to come. The answer was in providing a group of power centers that can be quickly and easily expanded into a secondary network system as new buildings planned are put in place. Here's Westinghouse equipment matched with a plan for expansion.

Westinghouse, in cooperation with Intermountain Chemical Co., Westvaco Division, Food Machinery Corp., developed here a complete power distribution system, providing benefits not only of an integrated arrangement, but of one company responsibility for design, manufacture and application of equipment.



YOU CAN BE SURE...IF IT'S

# Westinghouse can help you match planning with equipment . . .

## to bring your distribution system up to par

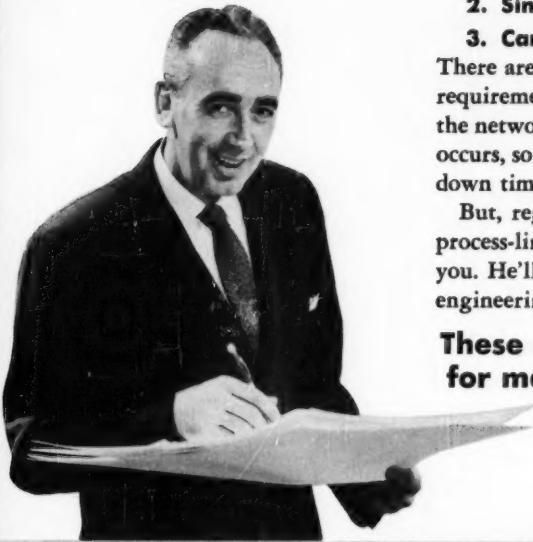
Early and thorough planning of your power distribution system is the only effective answer to these three basic questions:

1. **Will my electrical system be adaptable to changing load conditions with minimum service interruptions?**
2. **Since down time is very costly, will I get maximum reliability?**
3. **Can I get good voltage regulation in spite of load fluctuations?**

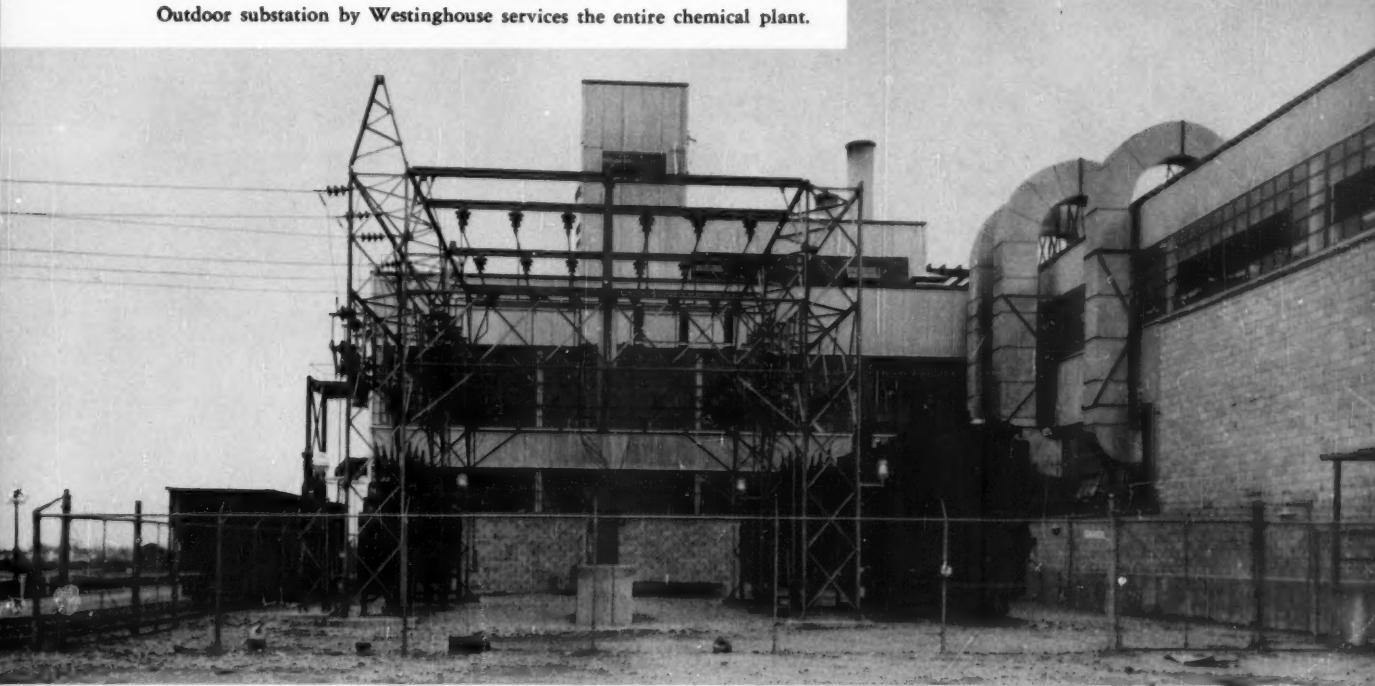
There are many fine electrical systems that can be adapted to fit your process requirements. One modern way to support heavy production schedules is with the network system. This system provides alternate power routes when trouble occurs, so that faults on the line can be shared throughout the system, without down time—a kind of electrical insurance.

But, regardless of the system selected, plan it early, and well, along with process-line planning. Your Westinghouse Representative is ready to assist you. He'll make available to you not only the right equipment, but also the engineering services you need to get started on the right foot.

## These chemical plants integrated secondary power for more efficient, dependable production



Outdoor substation by Westinghouse services the entire chemical plant.



# Westinghouse

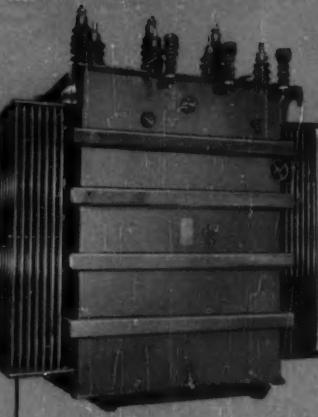


## Westinghouse coordinated distribution equipment maintains constant throughput

It's not good business to gamble against power failure when the penalties run high on continuous process lines. And there *are* ways of providing maximum reliability, without standby diesel-generator sets or other expensive makeshift arrangements.

This choice of types of equipment and the kind of power distribution layout will depend on the problems in your plant—change-over, expansions, modernization, new processes or products, and so on. Westinghouse can help you select the right equipment and coordinate it to bring out the specific advantages that best suit your requirements.

On these pages are shown several of the major product elements of a typical process power distribution system, and what each can contribute to its over-all effectiveness.

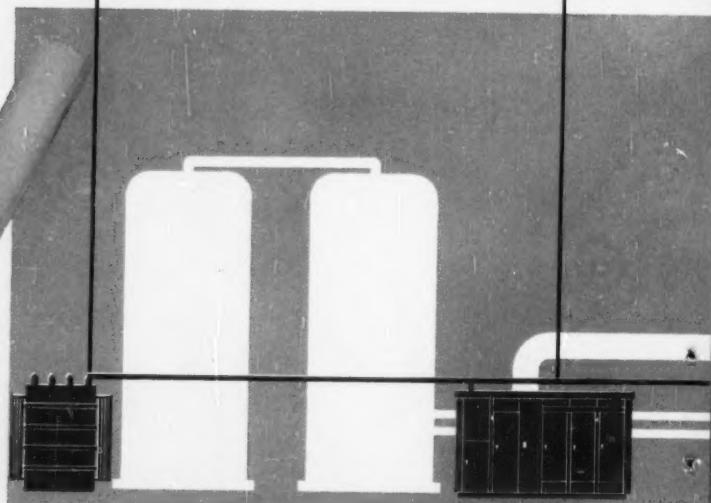
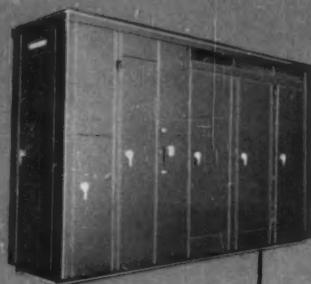


### Standardized Type SL Transformers

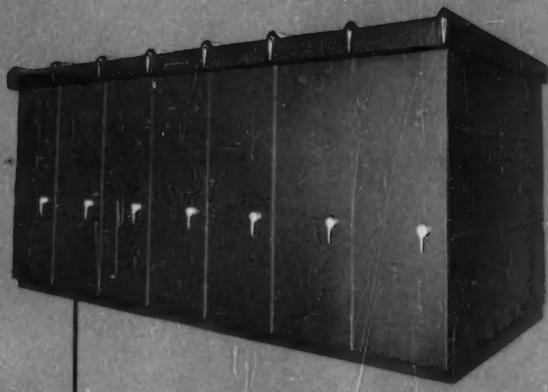
Liquid-Filled Westinghouse Type SL Distribution or Power transformers for chemical use offer the many economies of standardization, plus design advantages based on years of tested and proved experience.

### Capacitors

Large Metal Enclosed Westinghouse Capacitor Equipment provides important cost savings, by improving voltage regulation and reducing ampere loading on circuits and transformers. For indoor or outdoor use, these capacitors are rated 230 to 13,800 volts.



YOU CAN BE **SURE**...IF IT'S



#### Metal-clad Switchgear

To protect heavy capital investment and prevent costly interruption of chemical processes, switchgear must be exceptionally reliable. Westinghouse Metal-Clad Switchgear more than meets this basic requirement — offers outstanding advantages for chemical service.

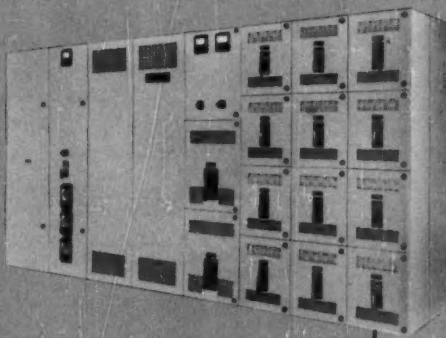
DH Air Circuit Breakers provide positive protection — employ De-ion® arc extinction, the most effective method known. There's less contact burning—less maintenance—more reliability. Breakers draw out horizontally — can be changed in three minutes flat, vital for service continuity.

Corrosion is licked by Bonderizing enclosures *after* assembly — prime and finish painting. For outdoor service, undersurfaces are protected by an all-weather coating.

Standardization in manufacturing keeps your costs down. Special engineering is eliminated. Switchgear can be expanded, re-arranged or relocated with only minor wiring changes and no loss in value.

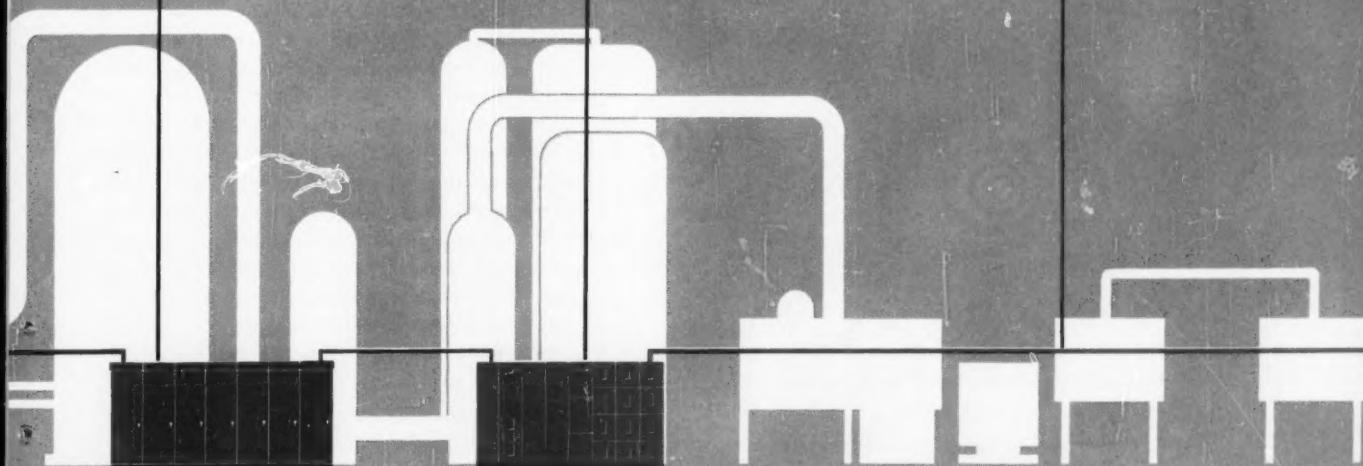
#### Dry-type Power Centers

Westinghouse Dry-Type Power Centers include in one line-up an air-cooled power transformer, high and low voltage switchgear equipment—all coordinated and tested at the factory for highest operating efficiency. Since all parts are of Westinghouse manufacture, you receive the plus benefits of unit responsibility.



#### Bus Duct

Bus duct is the modern, convenient way of carrying power in both distribution and utilization loads over long or short runs. Four types provide for economical and efficient handling of power under all conditions, indoors and out.

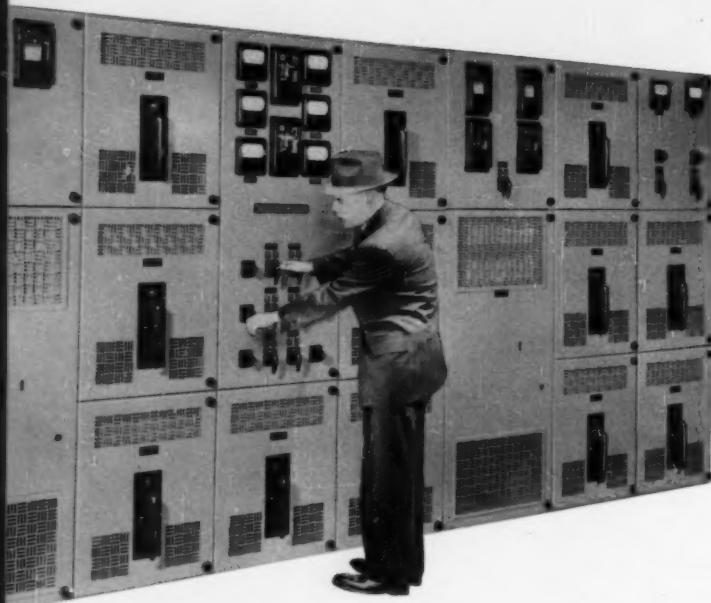


**Westinghouse**



**EQUIPMENT FOR SPECIAL PROCESS  
NEEDS ON THE FOLLOWING PAGES.**

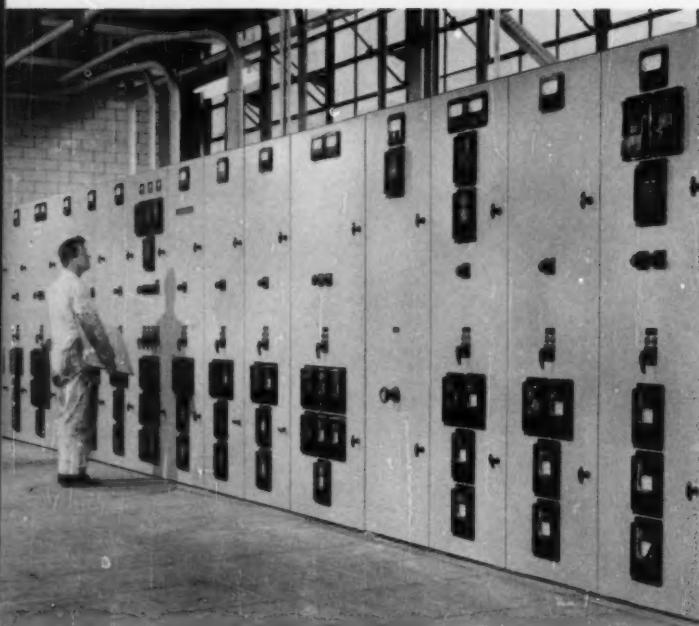
# Westinghouse equipment flexibility meets problems of



## ... special servicing, with Westinghouse Low-Voltage Switchgear

One basic problem is obsolescence, not only of production equipment, but of the arrangement of power serving that equipment. Here are three outstanding advantages of Westinghouse Low-Voltage, Metal-Enclosed Switchgear to help you in this servicing problem.

1. **Unitized design eliminates special design and engineering expense for the original installation and, at the same time, provides custom-built precision in meeting application requirements — number and rating of breakers; selection of attachments, instruments and relays.**
2. **With 10 basic units and a selection of standard instrument panels, future additions or replacements can be easily and quickly made any time.**
3. **All breakers are of drawout type and can be moved from "connected" to "test" or "disconnected" positions, or removed completely.**



## ... special safety requirements, with Westinghouse High-Voltage Switchgear

Westinghouse High-Voltage Switchgear is completely dead-front. All breakers may be closed or tripped without opening doors or otherwise exposing live parts. Each breaker is enclosed in an individual metal compartment. Interlocks are provided so that the compartment door cannot be opened while the circuit breaker is closed. Bare buses, cable connections and instrument transformers are placed in full-height rear compartments and separated from breaker compartments. Interlock and positioning devices assure safe removal or replacement of breakers.

As added protection, Westinghouse Switchgear structures are completely Bonderized after fabrication, inhibiting corrosion and assuring a long-lived finish.

YOU CAN BE SURE...IF IT'S **Westinghouse**



## **... especially designed capacity, with Westinghouse Power Centers**

Dry-type power centers, capable of being installed in the center of your load area, give you all the advantages of high voltage close to the load. For instance you will gain:

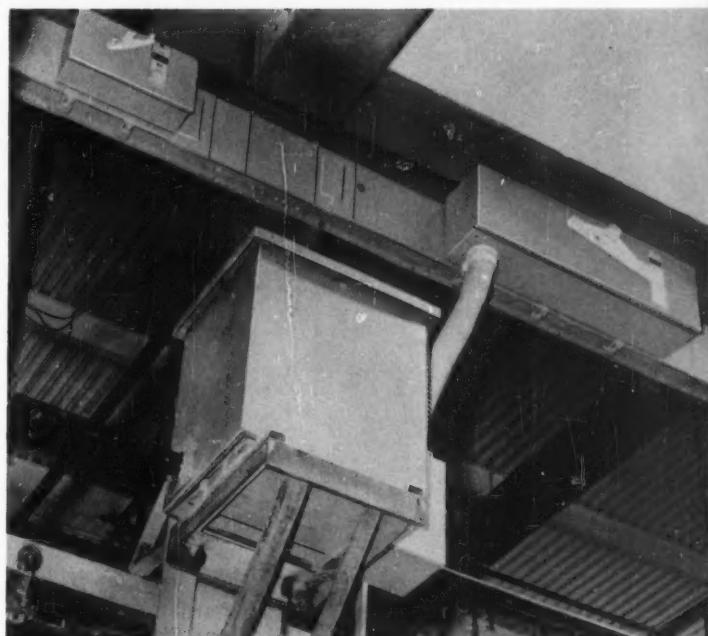
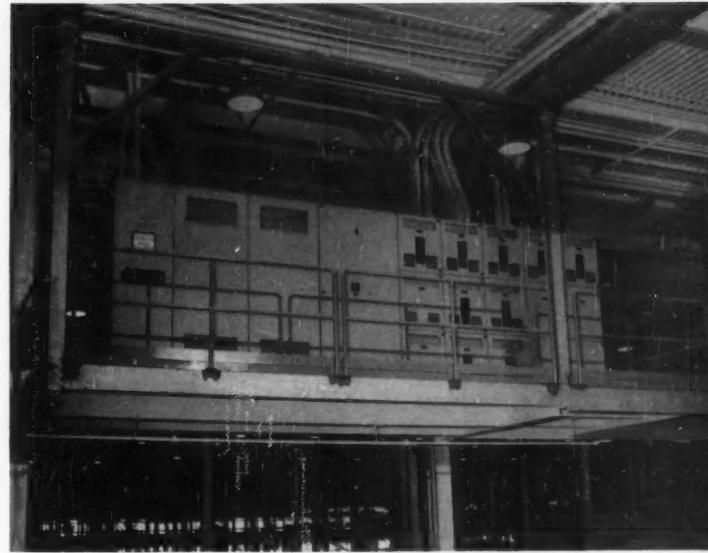
**Greater Safety**—Because of their inherent design which eliminates the need for oil, Westinghouse Dry-Type Power Centers are safe from explosion. No vaults or safety barriers are necessary.

**Lower Line Loss**—By installing a Westinghouse Power Center in the center of your load area, you eliminate the need for long secondary lines and their resulting power losses. A loss of only 10% of rated voltage can cut furnace heat generation, for instance, to 81% of normal.

**Improved Regulation**—Voltage drop on power lines to motors causes low starting torque and increased heating, lessening their efficiency and shortening service life. Westinghouse Dry-Type Power Centers help minimize operating voltage drop and assure good regulation.

**Lower Secondary Cable Costs**—Shorter secondary lines mean substantial savings in copper. Realizing these savings throughout an entire plant distribution system can reduce over-all investment considerably.

Power centers include transformer and switchgear in one compact structure.



## **... especially designed spaces, with Westinghouse Bus Duct and Dry-Type Transformers**

Westinghouse Bus Duct is an ideal power distribution medium, because of its universal flexibility. It can be installed quickly and easily to suit physical space needs of your plant. Duct is available in 10-foot prefabricated sections with elbows, tees and crossovers, so that the line can be run in any direction, around obstructions and corners. It can be placed flat or endwise, in batteries or singly, against ceilings or walls, parallel with air-conditioning duct or other lines—and with complete safety. Tight layouts and obstacles are no problem.

In modernization or conversion work, duct is fully salvageable. It can be dismantled, reassembled, expanded—no expensive altering or moving of structures and equipment often necessary with con-

duit-cable systems. Specify flexible Westinghouse Bus Duct.

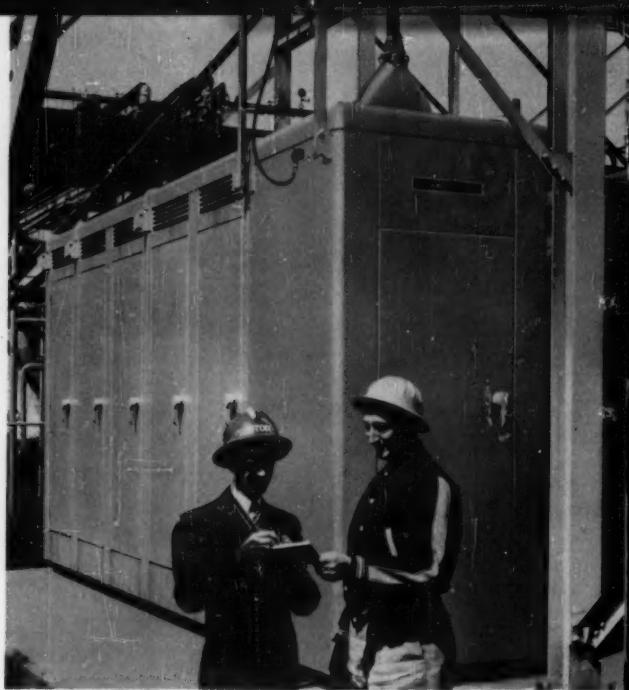
In the picture above, underneath the bus duct, is a Westinghouse AVR dry-type transformer. Placed strategically throughout a plant, these transformers bring power conveniently, economically close to the load. Basically simple, dry types contain no liquids to change and are therefore easy to maintain, safe from explosion.

## Large metal-enclosed capacitor equipments control voltage levels

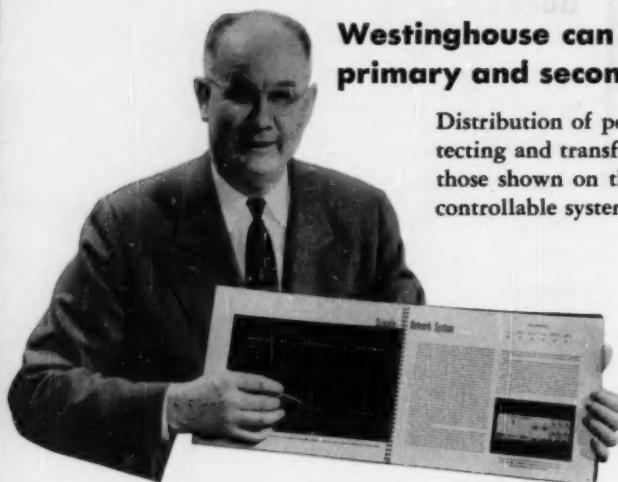
Today, in many chemical plants, large amounts of kilovars are needed to provide voltages at levels required for efficient operation of process equipment and maintenance of product quality.

Westinghouse Inerteen® Capacitors are the ideal source of these kilovars. Capacitors are low in initial cost, require less maintenance than other methods and save additional investment in transformer capacity.

For these applications, Westinghouse offers metal-enclosed capacitor equipments—capacitors, fuses, busbars, connections, switches and accessories enclosed in safe, weatherproof, metal housings. Averaging less than \$8.00 per kvar, these units are standardized in design and factory assembled—save engineering and installation expenses.



## Westinghouse can help you match up primary and secondary power



Distribution of power includes carrying, controlling, regulating, measuring, protecting and transforming electrical energy. Many pieces of equipment, other than those shown on these pages, must be considered in planning a flexible, reliable, controllable system. Your Westinghouse Representative can help you select them, coordinate them and tie them in with your primary power.

When you are planning on building, expanding or modernizing, call your local Westinghouse Office. We can offer you a complete line of electrical equipment, specifically designed for processing plants.

MP-3009

Mr. Perry Croce, Consulting & Application Manager,  
Central Region, Westinghouse Electric Corporation.

### Westinghouse maintenance service is nationwide

When repairs are needed, they can be made quickly and properly in any of 38 well-equipped apparatus Repair Shops spotted across the nation. Engineers, operating out of 56 Field Offices, are always ready to provide periodic inspections.

Fast delivery of genuine Westinghouse Renewal Parts from stock in 31 locations enables you to keep low parts inventories at your plant.

Check literature desired and send to Westinghouse Electric Corporation, 3 Gateway Center, P.O. Box 868, Pittsburgh 30, Pa.

Name \_\_\_\_\_

Firm \_\_\_\_\_

Address \_\_\_\_\_ City \_\_\_\_\_ State \_\_\_\_\_

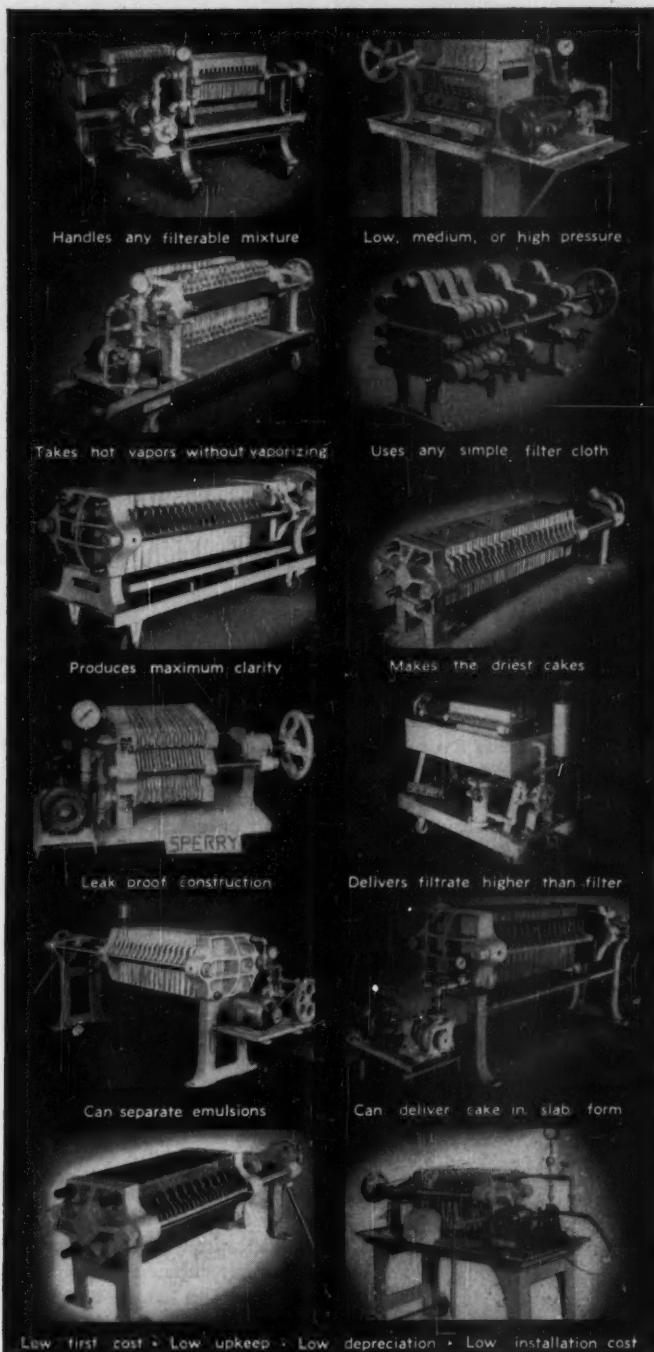
- Network Selector Card
- Heavy-Duty, Metal-Clad Switchgear **B-5306A**
- Power Centers **B-4162**
- Capacitors **B-3966A**
- Transformers That Cut Distribution Cost **B-4249A**
- Bus Duct Manual **B-4272B**

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MP-3009



Low first cost • Low upkeep • Low depreciation • Low installation cost

## **NEW SPERRY Catalog & Specification Book NOW AVAILABLE!**

Written more as a text and reference manual, this "encyclopedia of filtration data" improves your understanding of a vital process; aids in the selection of the proper equipment for your specific filtration requirements. Write for your free copy of this valuable booklet — today!



**THOUSANDS**  
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of industries . . .

built to **ONE**  
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If you can utilize the significant knowledge gained from this vast experience — consult Sperry for filtration, today!

### **SPERRY FILTER BASES**

All types . . . all sizes. Plain or punched to your specifications. Besides cotton and paper, bases are furnished in wool, synthetics, glass, and woven metals.



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Bldg., San Francisco 4, California  
DO 2-0375

# which is the QUALITY TANK?

Both tanks look alike, but only the **Q C f**-built tank has extra quality you can depend on! After fabrication, they are stress-relieved to eliminate stresses set up during forming and welding...providing resistance to fatigue caused by temperature changes or pulsating loads. Every inch of welding seam is *radiographed* to assure freedom from slag inclusions, porosity and undercutting. Tank exteriors are steel grit-blasted to remove mill scale, resulting in a smooth surface for the red lead primer. Exacting shop inspections with final Hartford Steam Boiler Inspection is standard practice in accordance with ASME 1952 Code W-XR-SR.

**Q C f** Tanks are available for propane, anhydrous ammonia, and other gases or liquids under pressure...with man-ways for thorough inspections and cleanings...with steel saddle supports for installation on flat foundations. For more specific information, write or call: Dept. 1-C, **Q C f** Industries, Incorporated, Industrial Products Division, 30 Church Street, New York 7, N. Y.

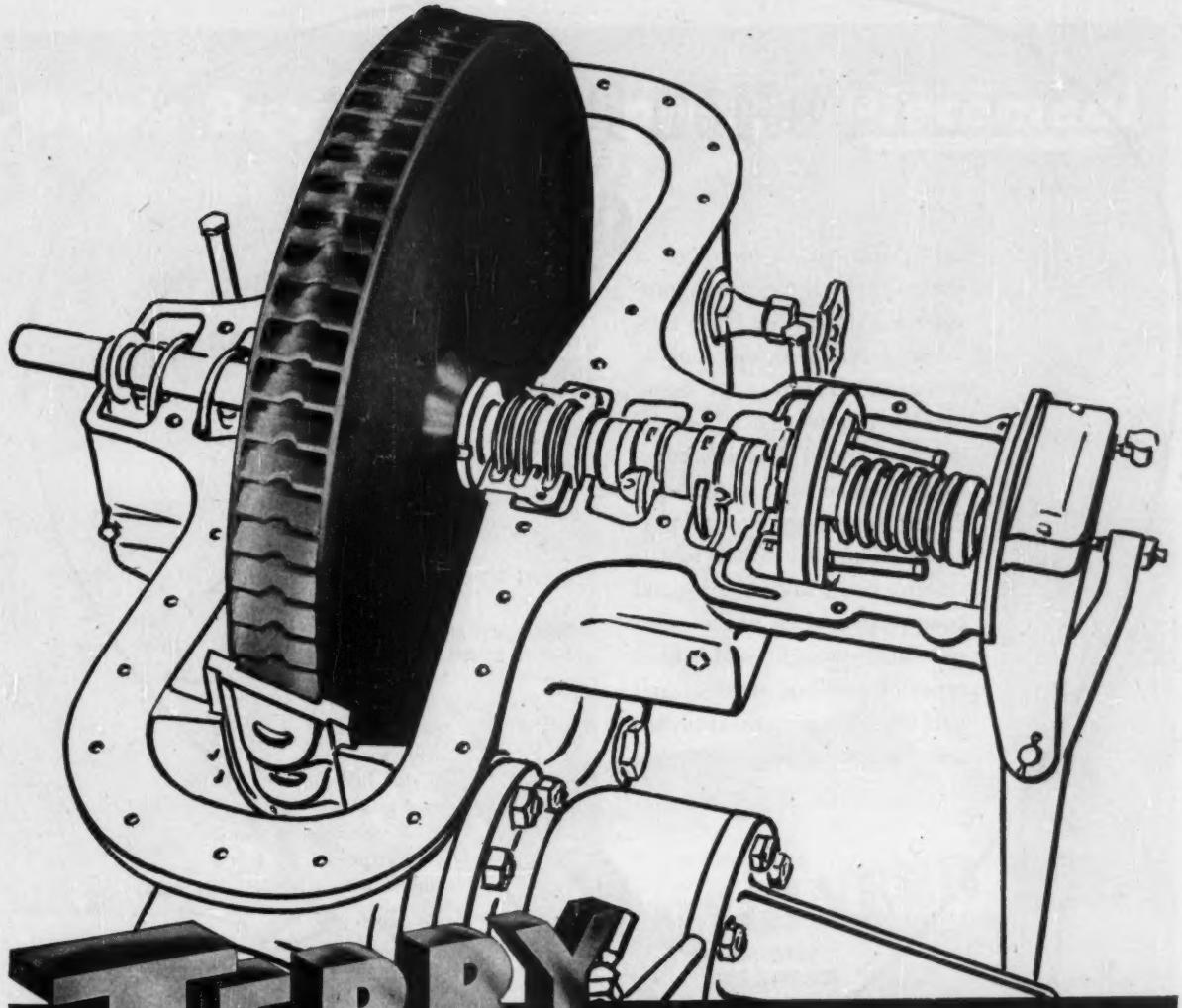
#### ask us

...about our new 30,000 gallon tank only 50 feet in length. Takes less installation space...allows single-car rail shipment and cross-loading on export barges. Weight: only 67,000 lbs...costs far less to ship!

*Quality you can trust*



....STORAGE TANKS • TRUCK TANKS • SAFETY VALVES



# TERRY

## SOLID WHEEL RUGGEDNESS

### is your turbine dividend

The rugged construction and fool-proof design of a Terry solid-wheel turbine can save you money by keeping maintenance costs to a minimum. Usually only taken down for routine inspection, any repairs that must be made are of relatively simple nature, and cost of replacement parts is small.

The rotor of the turbine is a single forging of special composition steel, in which a series of semi-circular buckets is milled. There are no separate parts to loosen or work out. As the only function of the blades is to form a series of pockets, any wear which might occur would not materially affect

horsepower or efficiency.

It is impossible for the blades to foul. They have large clearances and are further protected by the projecting rims of the sides of the wheel. As the side clearances are also very large, end play can do no harm.

The Terry solid-wheel turbine is an extremely reliable piece of equipment—why not write for complete details today? Ask for a copy of Bulletin S-116.

**THE TERRY STEAM TURBINE COMPANY**  
TERRY SQUARE, HARTFORD 1, CONN.

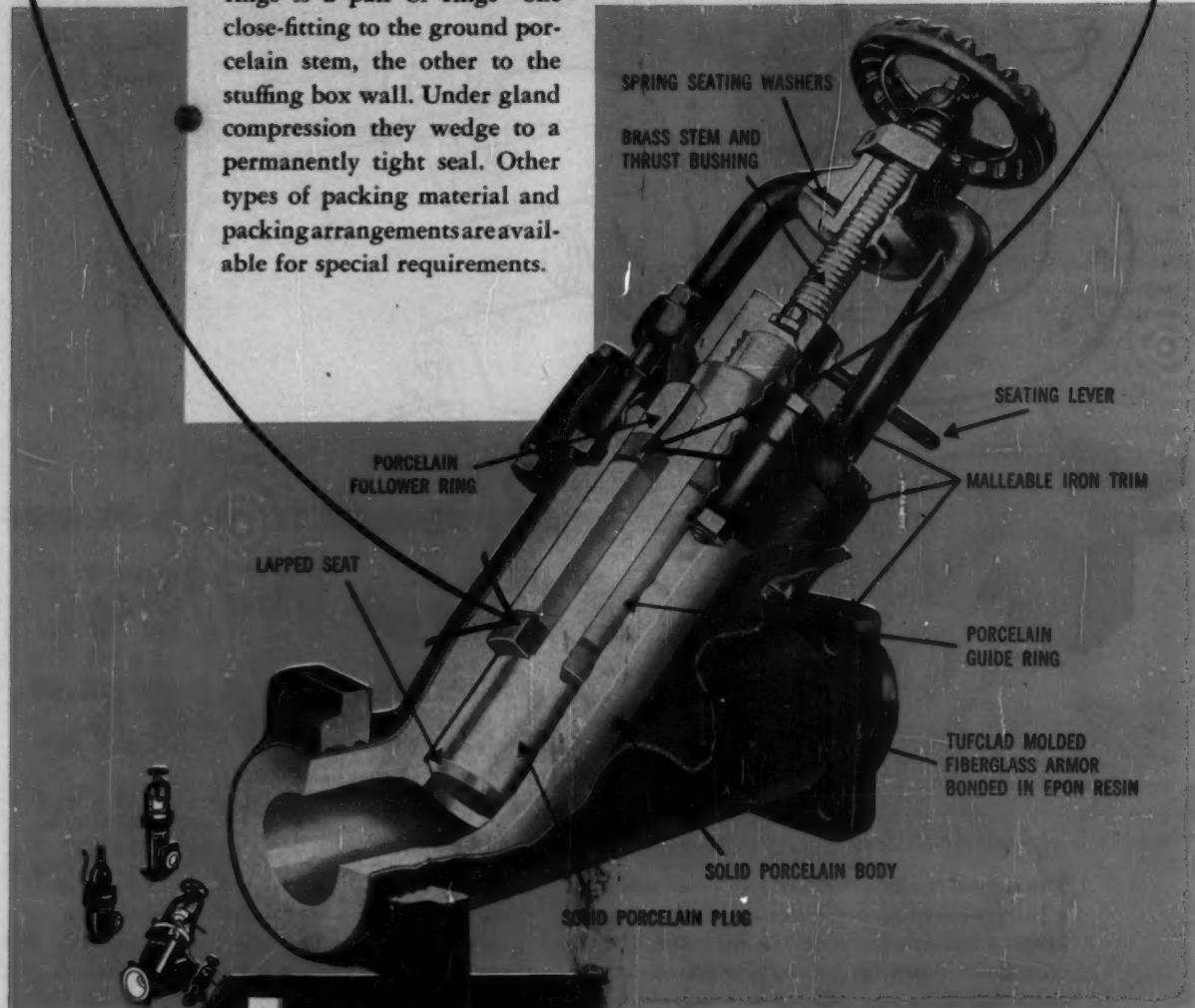
TT-1190

# Teflon Packing

... "all-service"

... maintenance-free  
in Lapp Valves

Solid, unfilled Teflon, in a wedge-ring arrangement, provides a packing for Lapp Porcelain valves which is long in serviceability, short on maintenance requirements. Each of the two sets of Teflon wedge-rings is a pair of rings—one close-fitting to the ground porcelain stem, the other to the stuffing box wall. Under gland compression they wedge to a permanently tight seal. Other types of packing material and packing arrangements are available for special requirements.



**Lapp**  
PROCESS EQUIPMENT

Chemical Porcelain Valves • Pipes • Roschig Rings  
Pulsefeeder Chemical Proportioning Pumps

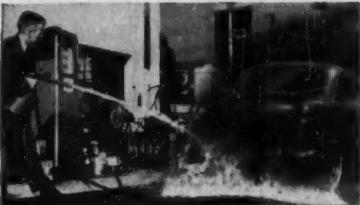
*Y-valves, angle valves, flush valves, safety valves, and plug cocks of Lapp Porcelain have standard bolt-circle flanges for easy connection to all piping and equipment. Write for bulletin with complete description, characteristics, and specifications. Lapp Insulator Co., Inc., Process Equipment Division, 310 Wendell St., LeRoy, N. Y.*

# **Don't Buy Fire Equipment Piecemeal**

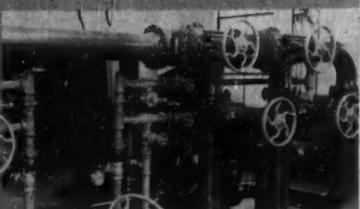


**Let Us —**

**FIRE-ENGINEER**



National Foam Portable Units



Engineered Foam Systems



Complete Line of Foam Products

## **THE CORRECT SYSTEM FOR YOUR PLANT**

You'll save money and risk by calling in National Foam "fire engineers." They survey your plant, analyze every process, location, flammable liquid used, flash points, existing system, water supply, and other factors. They recommend a basic AER-O-FOAM System with manual or automatic control, stationary or mobile operation. They prescribe the proper equipment — Foam Chambers, Overhead Units, Dip-tank Systems, Nozzles, Extinguishers. After installation you receive a complete operating manual.

Only National offers you one source for system design, equipment, and instant, positive, fire-tested AER-O-FOAM. Call on National today to discuss your flammable liquid risks.

Write for new, free booklet, "Foam Fire Protection."

**NATIONAL**

**FOAM SYSTEM INCORPORATED**

**Headquarters for Foam Fire Protection — WEST CHESTER, PA.**

A REPORT  
FROM  
*Roll-O-MATIC'S*  
FIRST  
(AND TOUGHEST)  
CUSTOMER!



**AAF General Office Building Serves as Proving Ground  
for New Automatic, Renewable Media Air Filter !**

IT looked good on paper; was sensational in the laboratory. But how would it measure up in actual day-to-day service? AAF's General Office Building air conditioning system was selected as the "guinea pig" long before the ROLL-O-MATIC ever made a public appearance.

Never has a filter had a more critical customer. Cleaning efficiency of the bonded glass fiber "blanket" was instrument-checked regularly. Media usage was measured meticulously. Every mechanical feature was observed and evaluated under true service conditions.

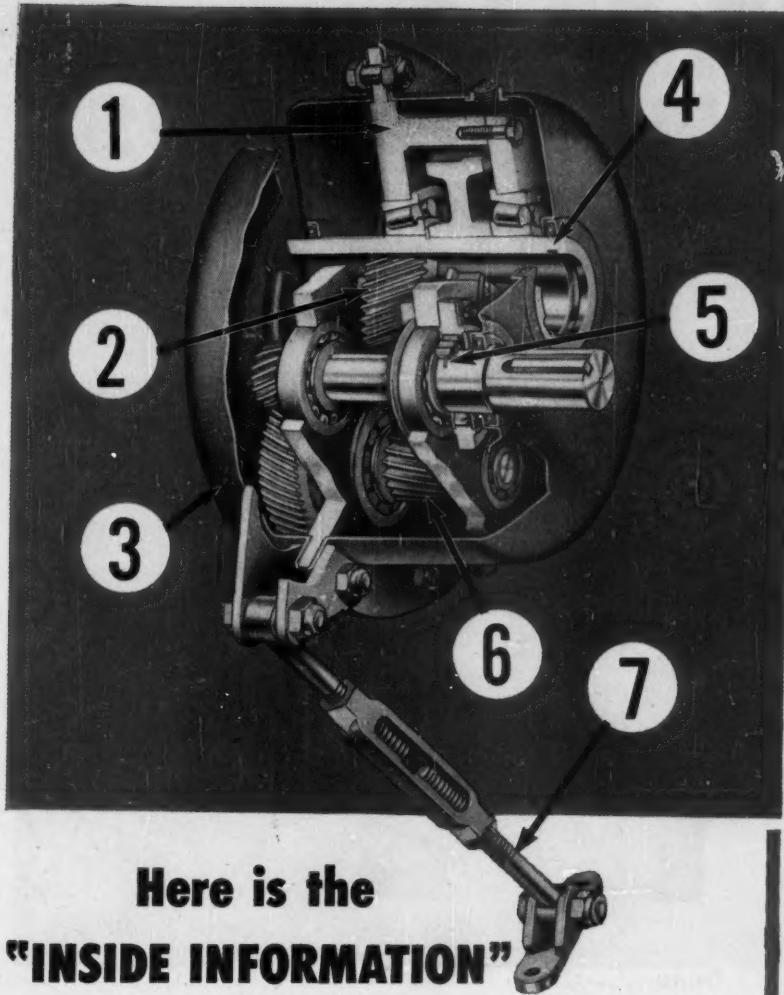
After months of this "filter clinic", ROLL-O-MATIC's first customer is also its most enthusiastic. AAF engineers have positive proof of this unit's maintenance-free operation. They know that ROLL-O-MATIC can deliver clean air continuously at an operating cost less than half that of a disposable type filter of equal capacity.

Yes, ROLL-O-MATIC efficiency and cost-cutting operation is a matter of record—a record which is now being duplicated by many installations. For complete facts, contact your local AAF representative or write for Bulletin No. 248.



**American Air Filter**  
COMPANY, INC.

American Air Filter of Canada, Ltd., Montreal, P. Q. • 326 Central Avenue, Louisville 8, Kentucky



## Here is the "INSIDE INFORMATION" on FALK <sup>ALL-STEEL</sup> Shaft Mounted Drives

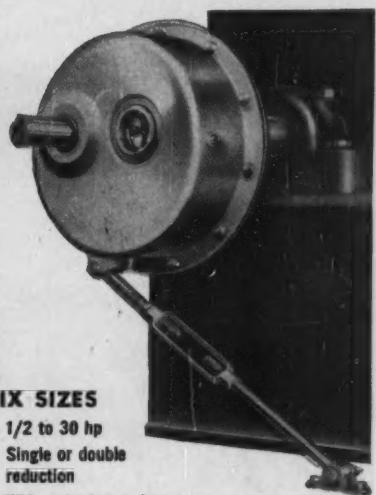
Take a careful look inside the Falk all-steel Shaft Mounted Drive, and you will know why this newest member of the famous Falk family is ideal for applications where direct mounting on the driven shaft is desirable. It is the only drive in its field with all these superior "In-built" factors:—

- 1 **All-steel Frame**, with more than double the rigidity of iron, supports all rotating elements.
- 2 **Precision Helical Gears**, designed and machined by Falk, rated to AGMA standards.
- 3 **Pressed Steel Housings**, whose sole function is to keep oil in, dirt out; easily removed for gear inspection without dismounting unit.
- 4 **Through Hollow Shaft** with counter bore provides for easiest installation or removal from driven machine shaft extensions.

- 5 **Backstop** can be furnished with the unit or added later for positive prevention of reverse rotation.
- 6 **Positive Lubrication**, continuous direct dip of revolving elements at all speeds.
- 7 **Tie Rod** and turnbuckle serve as anchor and facilitate V-belt or chain adjustment.

**Write** to Department 247 for engineering bulletin, including selection and dimension details.

### EFFICIENT SPEED REDUCTION IN LIMITED SPACE



#### SIX SIZES

- 1/2 to 30 hp
- Single or double reduction
- Wide output speed range—420 to 10 rpm

Expressly designed for topflight performance on installations requiring considerable speed reduction in limited space, the all-steel FALK Shaft Mounted Drive has quickly won acceptance throughout industry. This sturdy, compact, versatile reducing unit is an ingenious variation of the highly successful FALK Motoreducer design, pacemaker in its field for more than 20 years. Here, the time-proved design is adapted for mounting directly on the shaft to be driven, using V-belt connection to motor. Investigate now!

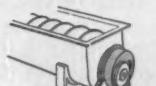
#### A FEW TYPICAL APPLICATIONS



APRON FEEDER



LINE SHAVING



SCREW CONVEYOR



BUCKET ELEVATOR



BELT CONVEYOR



GRAVEL CLASSIFIER

# FALK

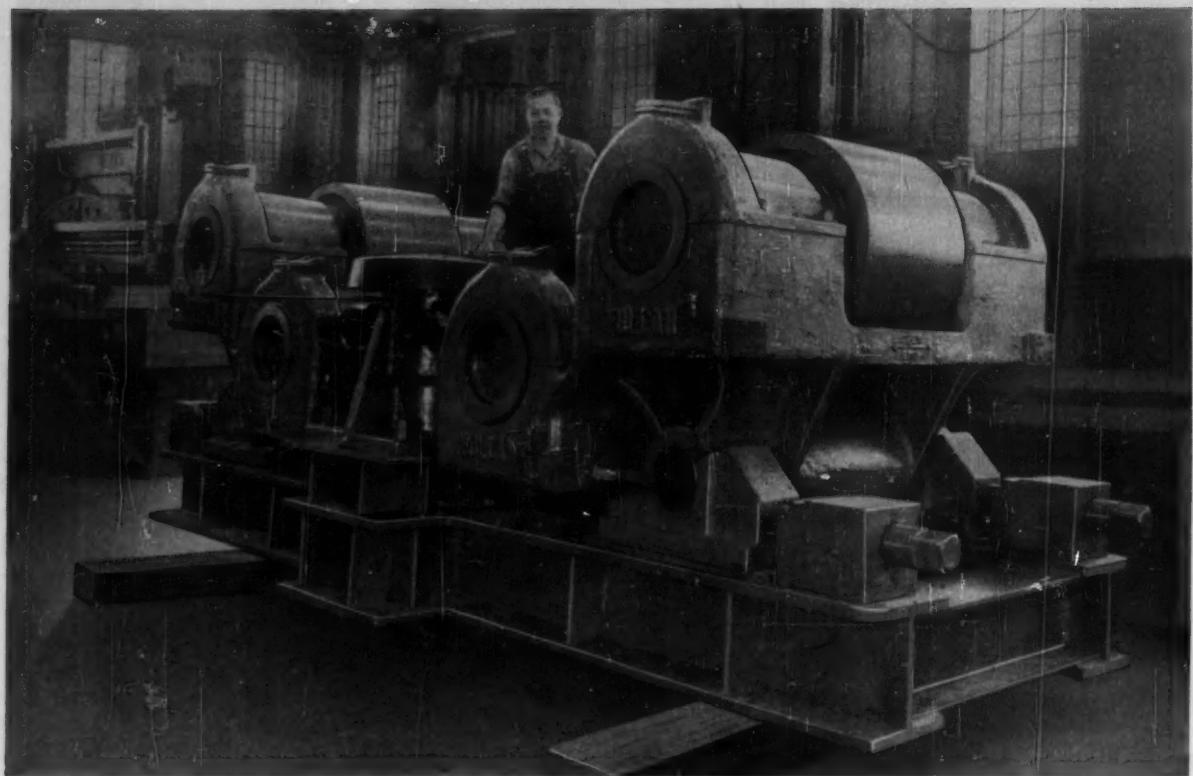
...a good name in industry

THE FALK CORPORATION, Milwaukee 8, Wisconsin

#### MANUFACTURERS OF

- Motoreducers
- Speed Reducers
- Flexible Couplings
- Shaft Mounted Drives
- High Speed Drives
- Special Gear Drives
- Single Helical Gears
- Herringbone Gears
- Marine Drives
- Steel Castings
- Weldments
- Contract Machining

# THE BEST SEAT IN THE HOUSE



## MADE BY VULCAN...

Yes sir . . . the best seat you can find for any size Kiln is made by VULCAN.

Shown above is one of two sets of (seats) supporting bearings now being assembled at the VULCAN IRON WORKS, in Wilkes-Barre, Pa. The cradle was made at VULCAN of open hearth cast steel, and contains the latest type VULCAN supporting roller and thrust bearings, all of which are automatically lubricated and easily adjusted to compensate for wear and misalignment.

When complete, these bearings will seat a 12' x 175' VULCAN Rotary Kiln that will be used for the production of titanium oxide.

VULCAN designed, VULCAN built equipment means good, dependable equipment. Our 105 years of continuous business, means Experience.

When you build or re-build, contact VULCAN of Wilkes-Barre. Let their experience in design . . . experience in building, work for you. Estimates, constructive suggestions, and preliminary drawings will be furnished (as far as possible) without obligation. Write for Bulletin A-422 on Rotary Kilns, Coolers, Dryers, Retorts and other dependable processing equipment, today.

Any information on items listed below  
will be sent to you immediately:

Rotary Kilns, Coolers and  
Dryers  
Rotary Retorts, Calciners, Etc.  
Improved Vertical Lime Kilns  
Automatic Quick-Lime  
Hydrators  
Briquetting Equipment  
Open-Hearth Steel Castings

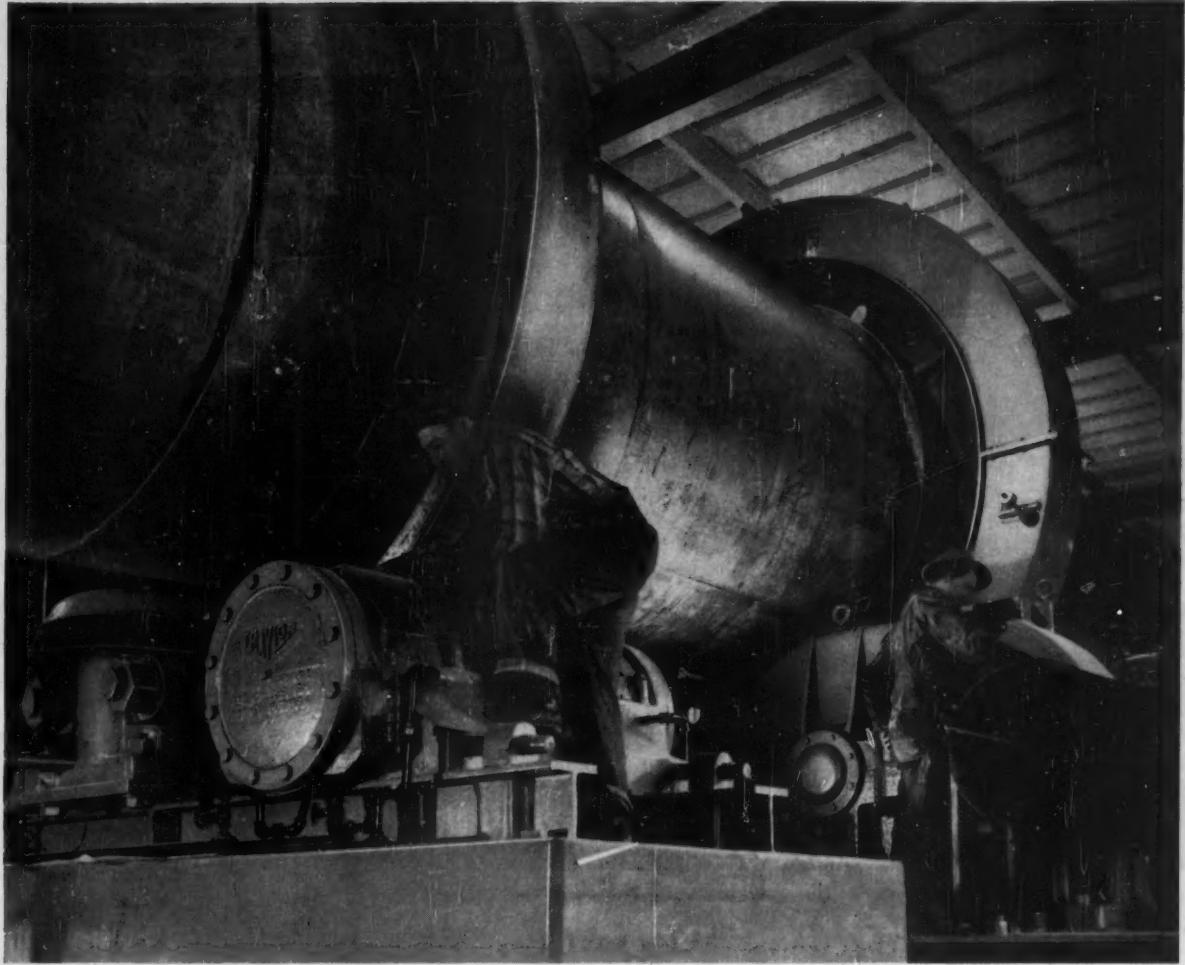
Heavy Duty Electric Hoists  
Self-Contained Electric Hoists  
Cast-Steel Sheaves and Gears  
Diesel Locomotives  
Electric Locomotives and Larrys  
Steel Plate Fabrications  
Hydraulic Presses

## VULCAN IRON WORKS

NEW YORK OFFICE  
50 CHURCH ST., N.Y., N.Y.

WILKES-BARRE, PA., U.S.A.  
ESTABLISHED 1849

CABLE ADDRESS  
"VULWORKS WILKESBARRE"



## does your kiln have "callers"?

When you operate Traylor Rotary Kilns, you never know when a Traylor Engineer is going to drop in. He makes it his business to keep in touch . . . to see that your Traylor Kilns are doing their best for you. A simple adjustment, a suggestion or two, can easily result in extra profits from your calcining operation.

These periodic visits are one of the big advantages of doing business with Traylor. They turn a "Traylor-made" Kiln into an investment that pays regular dividends throughout its long operating life. If you need advice on Rotary Kiln operation, drop us a line. A Traylor Engineer will be glad to call.

**SEND FOR BULLETINS . . . just mention the Traylor Equipment that interests you.**

TRAYLOR ENGINEERING & MFG. CO.  
701 Mill St., Allentown, Pa.

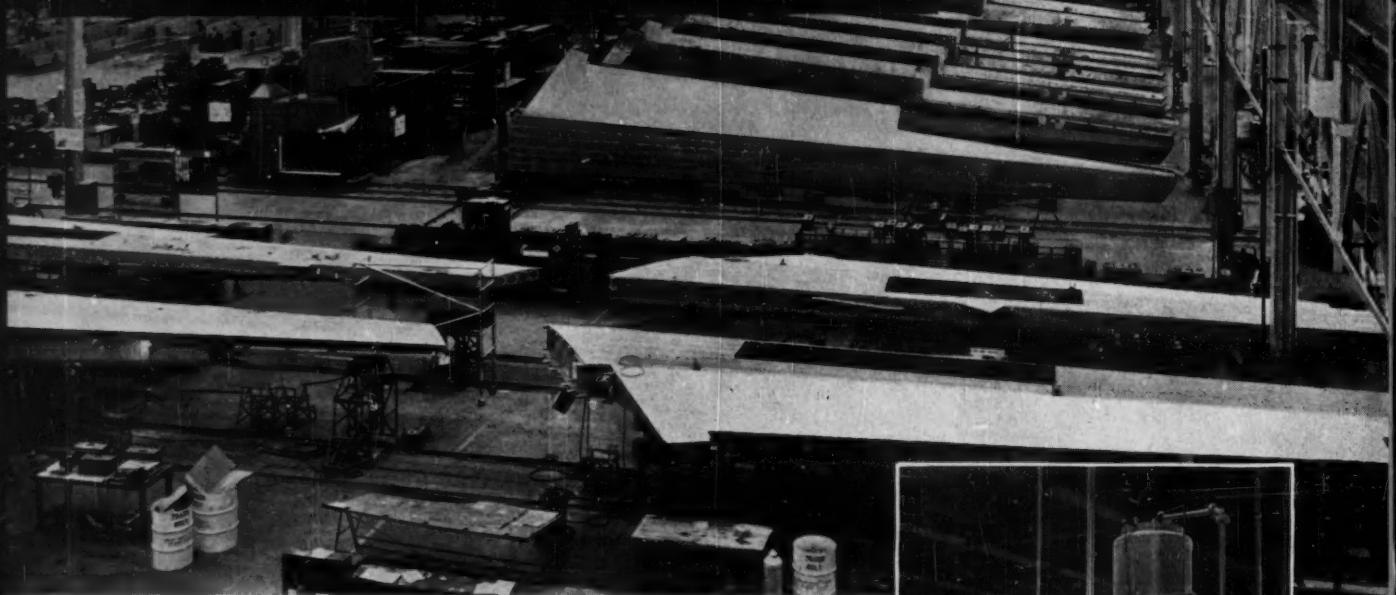
Canadian Mfrs.: Canadian Vickers, Ltd., Montreal, P. Q.



SALES OFFICES • NEW YORK • CHICAGO • SAN FRANCISCO

CHEMICAL ENGINEERING—January 1955

# FORD MOTOR COMPANY protects Stratojet bomber wings from CORROSION!



## *Permutit Ion Exchangers increase resistance to corrosion, also eliminate chromate waste disposal problem*

• Ford's Kansas City aircraft plant keeps a sharp eye on every operation. Wings for Stratojets must have a perfect finish for aerodynamic smoothness . . . one that holds up in rough service.

**Durable, hard coatings!** The life of Ford's anodic film, its appearance and corrosion-resistance depend on water quality in the bath makeup, rinsing and hot sealing. As in most plants, their water supply contains dissolved minerals. Slight traces . . . but enough to interfere with Ford's rigid standards.

**New method investigated!** Ford engineers looked into the ion exchange process for demineralizing water orig-

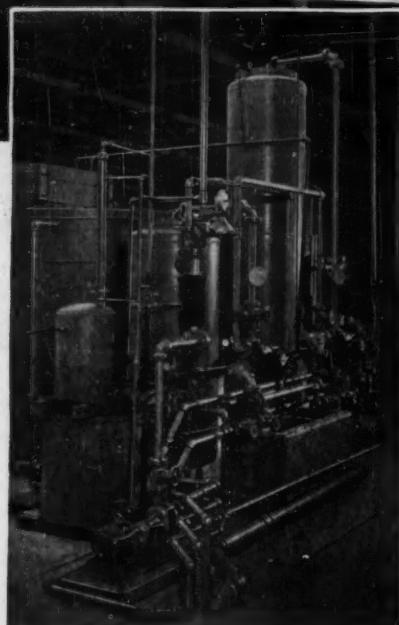
inated by Permutit. Here's what they got with the help of Permutit engineers.

### **Improved corrosion-resistance!**

Compact Permutit units (right) deliver mineral-free hot seal and rinse water . . . at the correct pH for best corrosion-resistance. The anion exchanger cuts chromate bills . . . recovers CrO<sub>3</sub> from dragout. This permits recirculating hot seals and rinses for big savings in fuel, water.

### **Waste disposal problem ended!**

Recycling water solves most of the disposal problem. The balance is handled by the Permutit cation exchanger. It removes trouble-making aluminum from the anodizing bath at the rate of

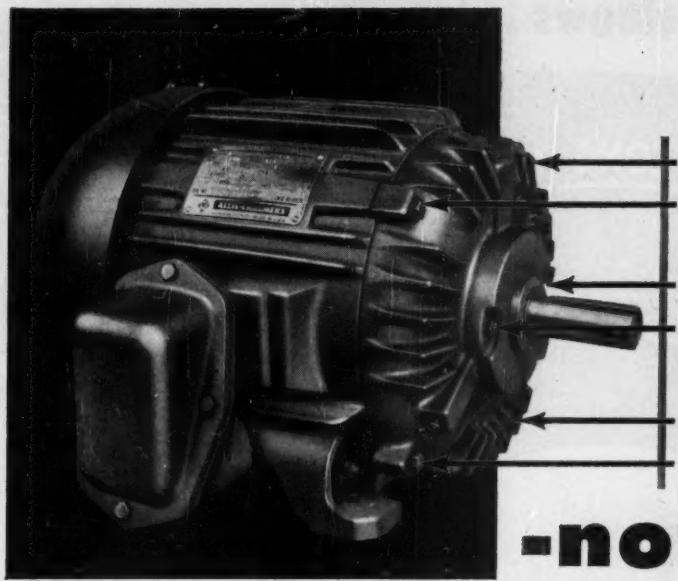


build-up. Wasteful draw-offs and dumpings are eliminated!

Combine these advantages and you'll find that you should consult Permutit with your problem. Write to The Permutit Company, Dept. CE-1, 330 West 42nd St., New York 36, N. Y., or Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

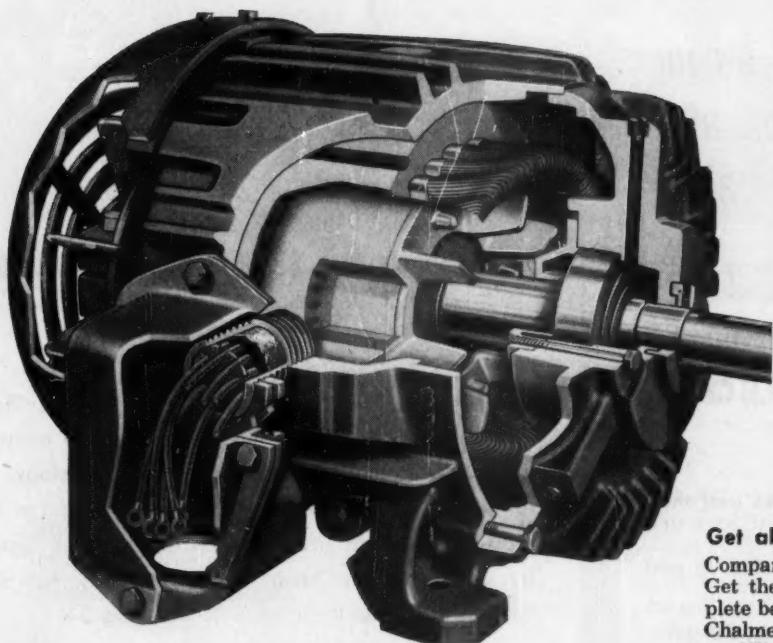
ION EXCHANGE HEADQUARTERS FOR OVER 40 YEARS

J  
**PERMUTIT**®



**It takes  
Six Bolts  
-not just four**

**to give full bearing protection  
for greater motor  
performance**



THE TWO EXTRA BOLTS in the end housing of every Allis-Chalmers ball bearing motor are the proof of extra protection against bearing failure. These are the bolts that hold the bearing cap tightly in place against the inner face of the bearing enclosure. This cap, with its close running clearances, keeps grease from the interior of the motor . . . retains an ample supply within the bearing enclosure . . . protects the grease and the bearing against contamination from dirt and moisture.

At the outer side of the bearing, double labyrinth seals keep grease in, also keep dirt out. What's more, large grease reservoirs act as additional dirt traps.

Result? Allis-Chalmers motors pay off in longer, trouble-free bearing life, lower motor maintenance.

Get all the facts . . . judge for yourself — Compare Allis-Chalmers motors with other motors. Get the six-bolt construction that gives you complete bearing protection. For proof, see your Allis-Chalmers Office or Authorized Distributor, or write — Allis-Chalmers, Milwaukee 1, Wisconsin.

**ALLIS-CHALMERS**



A-4340

**When you buy welding elbows . . .**



# Why take less when you can get more?

... (and at the same price)

## ADVANTAGES OF MIDWEST "LONG TANGENT" ELBOWS

- ★ They save pipe.
- ★ They often eliminate short nipples and their extra welds.
- ★ They save time and money in lining up and clamping pipe and fitting.
- ★ They make it easier to apply slip-on flanges.
- ★ They remove the circumferential weld from point of maximum stress and can be sleeved.
- ★ **THEY COST NO MORE THAN OTHER ELBOWS.**

As shown in the illustration above, Midwest "Long Tangent" welding Elbows have straight ends equal to  $\frac{1}{4}$  of the nominal fitting diameter (a 12" elbow has tangents 3" long). For the reasons listed at the left, substantial savings are made on many piping systems by using Midwest "Long Tangent" Elbows. For more information about them, write for Catalog 54.

## MIDWEST PIPING COMPANY, INC.

Main Office: 1450 South Second Street, St. Louis 4, Mo.

Plants: St. Louis, Passaic, Los Angeles and Boston

Sales Offices:

New York 7-50 Church St. • Chicago 3-79 West Monroe St.  
Los Angeles 33-520 Anderson St. • Houston 2-1213 Capitol Ave.  
Cleveland 14-616 St. Clair Ave. • Tulsa 3-224 Wright Bldg.  
Boston 27-426 First St.

STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

6722

**MIDWEST**

WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS

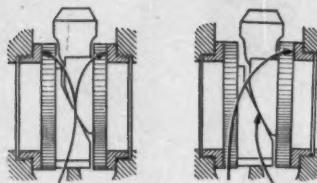
# 2 WAYS TO GET BETTER VALVE SERVICE!

1

## ...UNIQUE DARLING DOUBLE REVOLVING DISC, CAST STEEL GATE VALVE

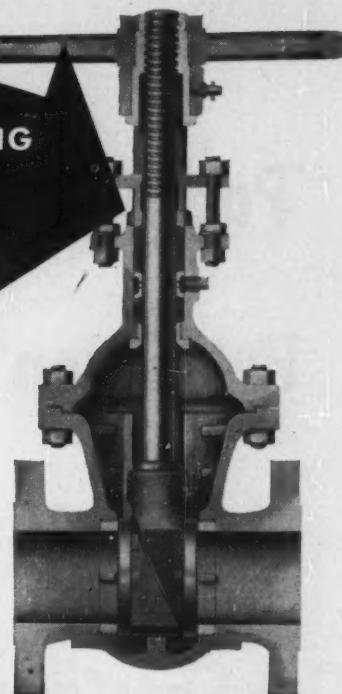
YES, here's a sure way to get better, more dependable valve service. Install this Darling gate valve of the fully revolving double disc, parallel seat type. Time after time users rate it number one for the elimination of down-time and repeated maintenance headaches.

Check the diagrams at right. Note how this Darling gate valve automatically compensates for body distortion, and resulting misalignment of seats. The upper wedge face is radiused, while the lower wedge face is straight, thus disc-to-seat pressure is equalized, assuring tight closure despite distortion and wear.



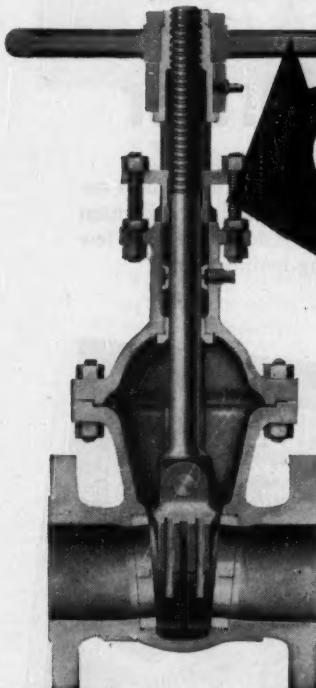
Discs and Seats forced out of parallel by body distortion but discs adjust themselves to give positive closure.

For foolproof simplicity in maintenance and reassembly, and unequalled service life, install this superior Darling Cast Steel Gate Valve.



2

## ...DARLING SLOTTED WEDGE CAST STEEL GATE VALVE



HERE'S the second good way to get better valve service. This Darling gate valve's slotted wedge provides flexibility when it's needed! It automatically compensates for expansion and contraction due to temperature changes, avoids leaks and minimizes wear and tear on the wedge faces and seats.

What's more, the wedge has double guide grooves which engage twin ribs in the valve body. This provides twice the usual bearing area, assuring smooth trouble-free alignment every time!

EVERY NEED. Darling gate valves are made in a wide range of sizes, types and constructions for all kinds of normal and unusual service... and for pressures up to 1500 pounds.



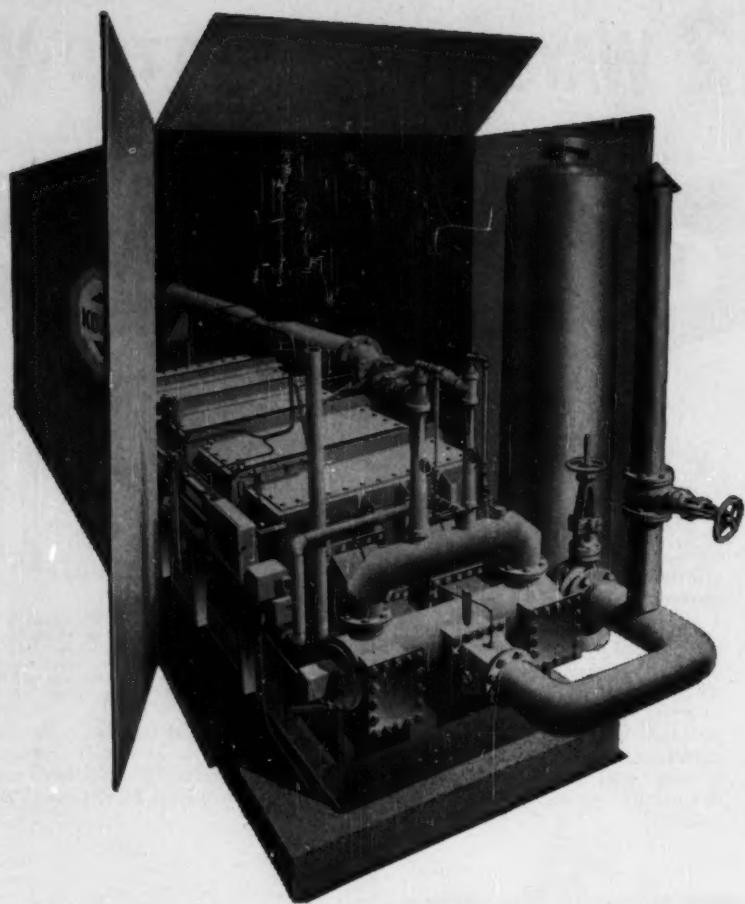
FOR PLUS VALUES,  
JOB-PROVED AGAIN  
AND AGAIN

# DARLING VALVE & MANUFACTURING CO.

Williamsport 3, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario

**"Packaged"**  
**Protection**  
**against**  
**Gas Shortages**



**...the Koppers-Hasche Reformer**

**A KOPPERS-HASCHE REFORMER** produces low-cost gas that is interchangeable with most natural or manufactured gases. It is, therefore, ideal insurance against gas-supply emergencies.

If there is any interruption in the supply of natural gas, a Koppers-Hasche Reformer can "carry on" until normal service is resumed. This stand-by service is valuable to industries that utilize natural gas, because it prevents costly interruptions in the manufacturing processes.

The Koppers-Hasche Reformer is available in standardized "package" units. Through standardization of design, prefabrication of parts, and shop assembly, the Kopper-Hasche Reformer can be installed in your plant at remarkably low cost.

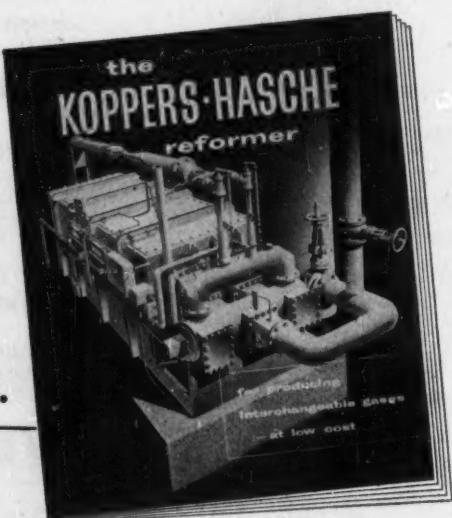
Operating cost is low, too. Units are almost entirely automatic in operation, requiring a minimum of operating labor and supervision. There are few moving parts, thus reducing maintenance.

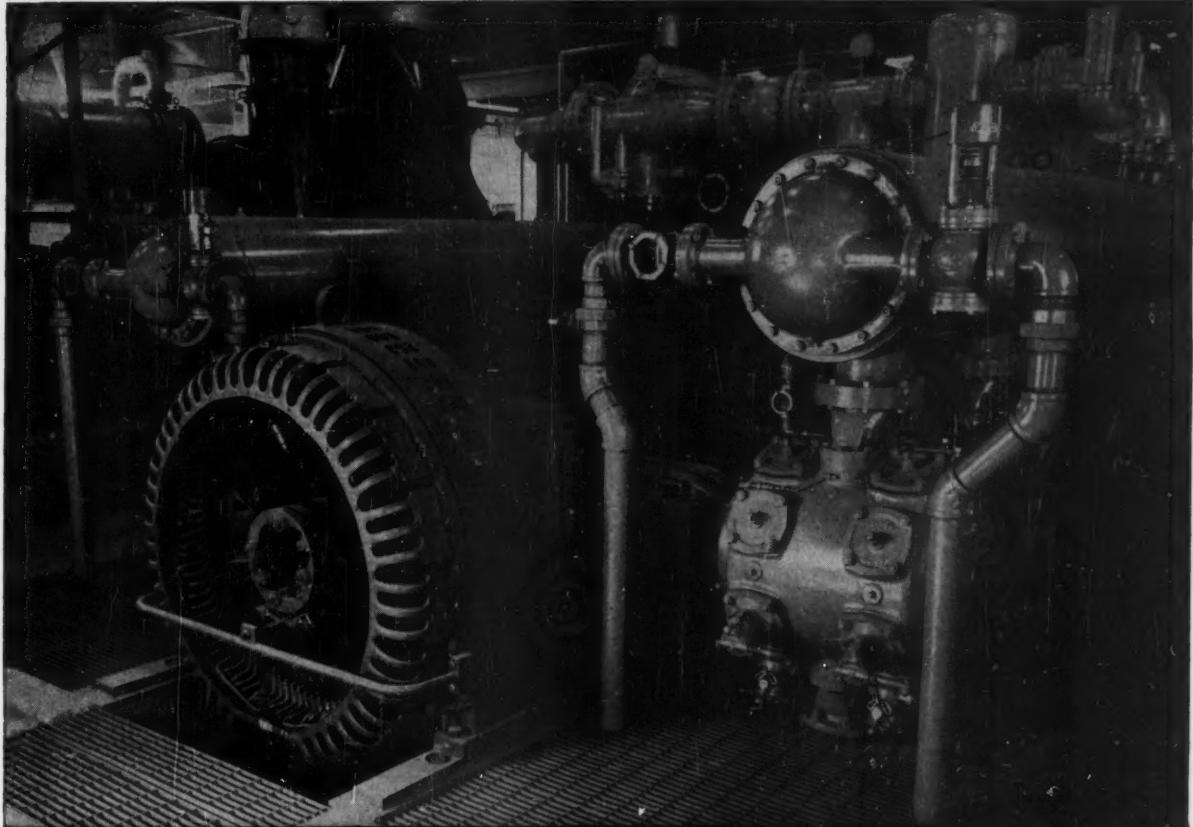
**For full details . . .** send for this booklet describing the Reformer, its operation and its adaptability. Just write to:



**KOPPERS COMPANY, INC.**

**Engineering and Construction Division  
Chemical and Gas Dept.  
Pittsburgh 19, Pennsylvania**





## CLARK BALANCED/OPPOSED COMPRESSOR

### Used for testing jet components in Bendix Aviation's new research center

Speeds up to supersonic levels! Atmospheric conditions ranging from sea level to 80,000 feet! Temperatures from minus 100° F. to plus 800° F. These are the conditions at which Bendix Aviation Corporation's new research facility at Teterboro, N. J. can test component equipment for jet aircraft and missiles.

Destined to save thousands of man-hours of engineering research, the new facility utilizes the latest combinations of pneumatic and electrical equipment. Playing an important part is a Clark 600 horsepower CMA-6, Motor Driven, Balanced/Opposed Compressor which supplies air at 200 psi for test purposes.

Because of the nature of the operation, per-

fect balance and accurate match of supply to demand, through flexible compressor cylinder loading, were important considerations in the selection of a Clark unit. Compactness saved considerable floor area.

A complete Clark line of Balanced/Opposed Compressors in the 150 to 4500 horsepower range is available in various cylinder arrangements to meet practically any requirement. A Clark representative will gladly furnish complete details. Write for Bulletin 118.

**CLARK BROS. CO. • OLEAN, N. Y.**

ONE OF THE DRESSER INDUSTRIES

Sales Offices in Principal Cities Throughout the World

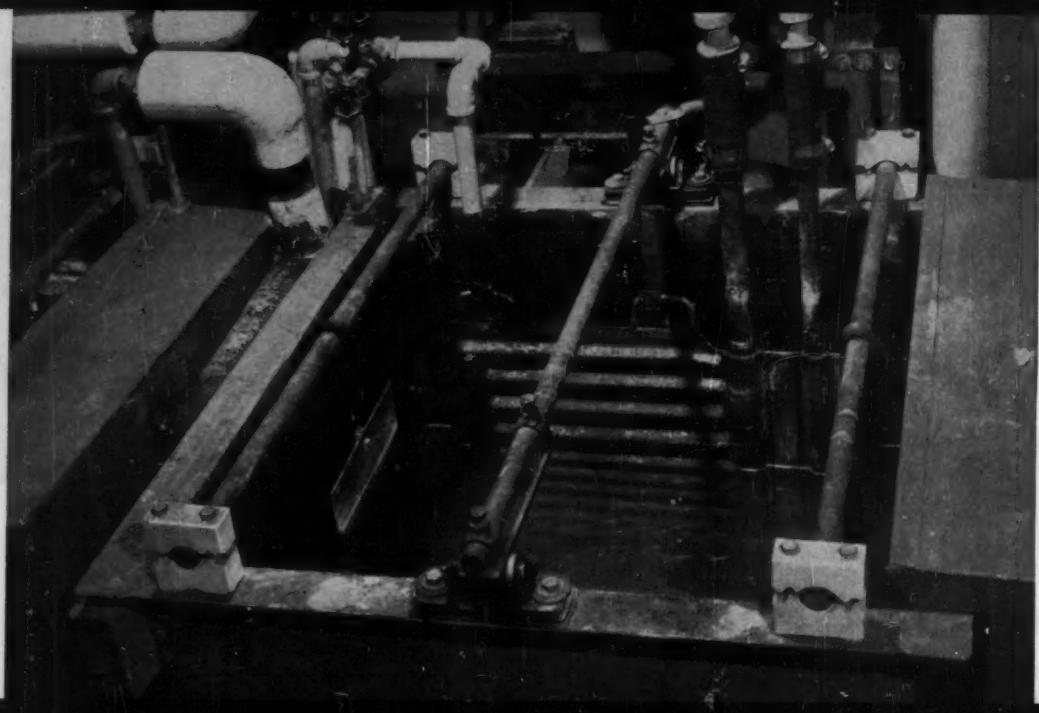
PRECISION BY THE TON

**CLARK**

**compressors**

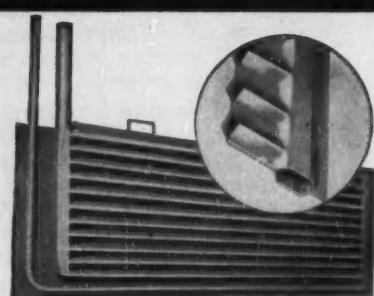
**new Wyandotte Research Laboratory  
uses PLATECOILS  
to prevent coil-it is \***

One of the finest technical laboratories in the country is the new Research Laboratory of Wyandotte Chemicals Corporation, Wyandotte, Michigan. A key feature of this laboratory is a series of 100-gallon plating and cleaning tanks made of various materials, such as rubber and plastic, which resist the actions of different types of chemicals. Individual tanks can be heated from room temperature to 212 degrees in less than an hour, by the Platecoil heat transfer units in the tanks. "We find Platecoil to be ideal because of their easy-to-clean surfaces and standardized performance," reports A. W. Liger, Supervisor of Industrial Research.

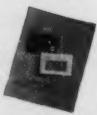


**PLATECOILS replace pipe coils  
for 50% of the cost**

\* Coil-it is the constant doctoring of wet processing tanks for pipe coil troubles. It can be cured easily by replacing pipe coils with Platecoils. Immediately, you will notice the difference as Platecoils put new life and profits into your heat transfer processes. They heat or cool 50% faster and take 50% less space in the tank. They save as much as 50% in initial cost and 50% in maintenance costs in addition to overcoming the limitations and operating difficulties of old fashioned and outmoded pipe coils.



Bulletin P61 shows how Platecoils are replacing pipe coils at a savings throughout industry. Send today for your copy.



**Platecoil Division, TRANTER MANUFACTURING, Inc., Lansing 4, Michigan**

*For fast shipment see your local distributor*

*Sometimes,  
all you need is  
the suggestion*



Mind you, we do not say that diatomite is the answer to your particular problem—but we do suggest that it may be. For it is, quite literally, amazing how often the unique properties of the finest diatomaceous materials (those which carry the Dicalite name) have proved to be the key to new products or better processes. Chemically inert, being practically pure silicon dioxide, very light in weight, with great surface area, Dicalite is used in filtering everything from antibiotics to zein; as a bulking agent and filler; as extender and as flattening agent; as a carrier and a diluent; and as insulation. As a filteraid, Dicalite provides a wide range of uniform materials which afford high throughput with filtration "sharp" enough to remove solids in the size range of bacteria. • We will be glad to aid you in any way we can. Our technical bulletins are free on request; we will forward samples, sufficient for ample tests, if you will tell us what the problem is. The services of our laboratories and technical department are yours without obligation in the working out of special problems. Just write us.



DICALITE DIVISION, GREAT LAKES CARBON CORPORATION, 612 SOUTH FLOWER ST., LOS ANGELES 17, CALIFORNIA



*Two famous engineering firms  
join forces to pool their process  
experience and resources . . .*

The Fluor Corporation, Ltd., Los Angeles, has purchased an interest in Singmaster & Breyer, Inc., New York City, an engineering firm with approximately 300 employees.

Established in 1927, Singmaster & Breyer, Inc. has specialized in process engineering for the chemical, petrochemical and metallurgical industries.

Since 1890, Fluor has served the petroleum, natural gas, chemical, power and allied fields with engineering, construction and manufacture of specialized products. Fluor also places special emphasis on process developments.

Each firm will retain its own identity and personnel who will work closely together on mutual projects, fusing their extensive knowledge and experience for greater service to their clients both at home and abroad.

**BE SURE WITH FLUOR**

THE FLUOR CORPORATION, LTD.  
LOS ANGELES 22, CALIFORNIA

FLUOR OF CANADA - TORONTO  
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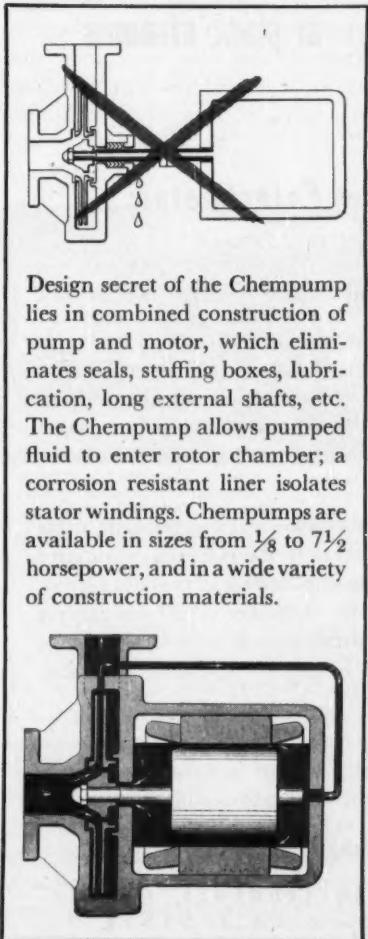
ENGINEERS  
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TULSA

# "CANNED ROTOR" PUMPS PAY OFF IN LOW UPKEEP COSTS, NO FLUID LOSSES

## UNIQUE CHEMPUMP DESIGN SAVES TRICHLORETHYLENE USER \$45 A DAY

Philadelphia, Pa. Officials of a large electrical switchgear manufacturer recently stated that \$45 per day savings of trichlorethylene resulted from installing a Model CF Chempump on a distillation-type degreaser. Fluid losses with the ordinary centrifugal previously installed averaged 25 gallons a day. "On top of this," they stated, "we had to repack the pump every two days. We'd tried all kinds of packing, some of them very expensive—but without luck. Since installing the Chempump, we haven't lost a drop of solvent, and there has been absolutely no maintenance."



Design secret of the Chempump lies in combined construction of pump and motor, which eliminates seals, stuffing boxes, lubrication, long external shafts, etc. The Chempump allows pumped fluid to enter rotor chamber; a corrosion resistant liner isolates stator windings. Chempumps are available in sizes from  $\frac{1}{8}$  to  $7\frac{1}{2}$  horsepower, and in a wide variety of construction materials.

## NUCLEAR SERVICE REQUIREMENTS SPUR LEAK-PROOF PUMP PRODUCTION

Less than two years ago, only one company in the country was producing and marketing a canned-rotor pump. Today, spurred on by the atomic energy program, half a dozen firms are at work on models for atomic-powered submarines, nuclear energy central stations, even atomic-powered aircraft.

To the man in the chemical process industries, all this is good news, because canned-rotor pumps can't

leak. They require no shaft seals or stuffing boxes, maintenance is practically nonexistent. And leakage losses, high maintenance costs are two of the biggest headaches centrifugal pump users face.

Canned-rotor pumps came about through the efforts of two young Philadelphia engineers, now officers and directors of the Chempump Corporation. Working on principles developed before World War II, they did further research and engineering, and in 1947 began production of a seal-less, canned-rotor pump.

Even while tooling up for production of this first model, the two designers were planning variations for specific applications in the chemical process industries. Pumps were built to handle extreme temperatures and pressures as well as a variety of corrosive fluids. The pumping requirements of chemical processors were carefully studied, and steps taken toward standardization of designs to meet those requirements.

1952 saw the formation of the Chempump Corporation to build canned pumps for the chemical process industries. Experience gained from nearly 15 years of laboratory and field testing went into the design and production of products offered by this corporation. First in the field of canned-rotor pumps, Chempump is also first with pumps tailored specifically to the chemical processing industry.



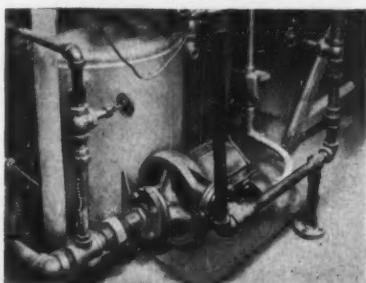
H. T. White and D. P. Litzenberg (left), developers of the first practical seal-less "canned-rotor" pump. On the desk are plans for an extreme-pressure, extreme-temperature design.

## PUMP SERVICE POLICY ENDS MAINTENANCE PROBLEMS

To reduce process downtime, many plants purchase a spare pump for every two, three, or five pumps installed, depending on circumstances. We feel this is a good policy, since downtime is limited to the time required to install a spare.

But what about repairing the faulty pump? Are proper spare parts on hand? How about maintenance department scheduling? The answer to these and other problems is the Chempump Service Policy. Any Chempump, damaged or inoperative for any reason—including improper pump application—will be repaired at the factory and returned to the customer with a new pump warranty. The pump is completely rebuilt, inspected and tested by factory experts . . . and the cost is moderate.

This service policy stops repair headaches, cuts spare parts inventory, and in effect, places a new pump on your shelves in short order.



Chempump handling condensate under extreme vacuum for large Eastern chemical manufacturer. Air contamination would render system inoperative.

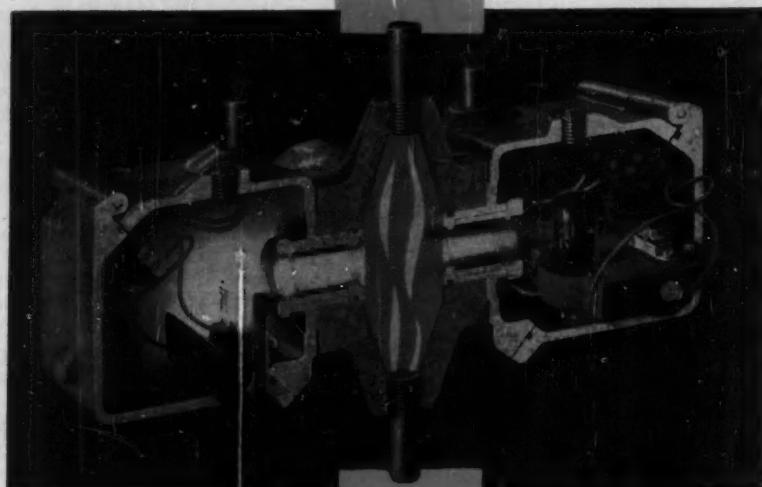
**Chempump**

First  
in the  
Field

**CHEMPUMP CORPORATION**  
1322 EAST MERMAID LANE • PHILADELPHIA 18, PA.

# Another step in Automation by Beckman

## Flow Colorimeter



continuously controls

Fluorescence  
Turbidity Color

in plant streams

### Three basic elements make up the Flow Colorimeter:

Do you have  
an application  
in your plant?

- monitoring clarity of liquids
- checking filtrates for filtering efficiency
- monitoring suspended solids
- monitoring nonmiscible drops suspended in a liquid
- determining color intensity

SOURCE A tungsten lamp is the radiation source. Filters select the color of light beamed through the flow cell.

FLOW CELL A stainless-steel casting with windows of ultraviolet-transmitting corex glass handles flows to 7 gpm, pressures to 150 psi. Flow cells can also be glass-lined or made specially from nickel alloys, plastic, etc. Path length can be 1, 2, or 5 centimeters. Openings provide ready access to inside of cell.

RECEIVER A sensitive phototube and exceptionally stable Beckman a-c amplifier measure the radiation transmitted through the flow cell. The amplified signal operates a standard potentiometer recorder. Amplifier circuit components are mounted in three separate plug-in units for immediate on-stream maintenance by regular operating personnel.

For additional information, write for Data File 90-14

Beckman

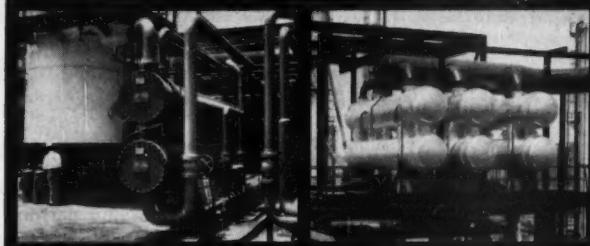
division

BECKMAN INSTRUMENTS, INC.  
FULLERTON 1, CALIFORNIA

The problem of getting a new plant on-stream...or an existing plant back on-stream after a shut-down...often depends on fast, well-coordinated engineering, fabricating and delivery of process equipment. Lost time may run into thousands of dollars a day.

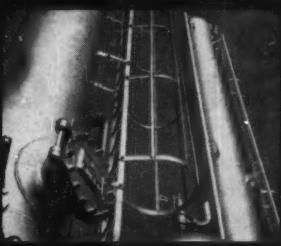
## *The Importance of On-Time Delivery*

That's why *personal expediting* is so important at SWECO. Getting your equipment delivered on time is a personal responsibility of one skilled SWECO engineer. He knows *your time* schedule. He follows...and leads...and pushes *your job* through every stage: initial engineering...shop fabrication and testing...shipment and delivery. He coordinates the work of SWECO's large staff of skilled process and equipment engineers...*on your job*. He knows the progress *on your job*, from day to day, in SWECO's extensive fabricating shops. He answers to you for on-time delivery.



SWECO LEAN MEA COOLERS used in Monoethanolamine system for removal of carbon dioxide from crude hydrogen gas at the Brea Chemicals plant in Brea, Calif.

SWECO CONDENSERS at the Standard Oil Company of California plant in El Segundo, condense cat cracker vapors into gasoline, using water as coolant.



SWECO ABSORPTION PLANT TOWERS and SWECO heat exchangers were recently put into use at this Shell Oil Company absorption plant in Brea, California.



SWECO HEAT EXCHANGERS are used in crude oil distillation, thermofor catalytic cracking, catalytic reforming and polymerization at this General Petroleum Corp. refinery at Ferndale, Wash.

SWECO has more than 30 years experience in engineering and fabricating heat exchangers, pressure vessels, towers and other process equipment...of carbon steel and alloy metals...for big and not-so-big customers...in many process industries...in all parts of the world. Talk with any SWECO customer and he'll tell you: Design and workmanship, tops. Reliability, none better. But a standout quality of SWECO service is personal expediting and on-time delivery. On your next job, consult SWECO. Send for brochure giving details of SWECO products and services.



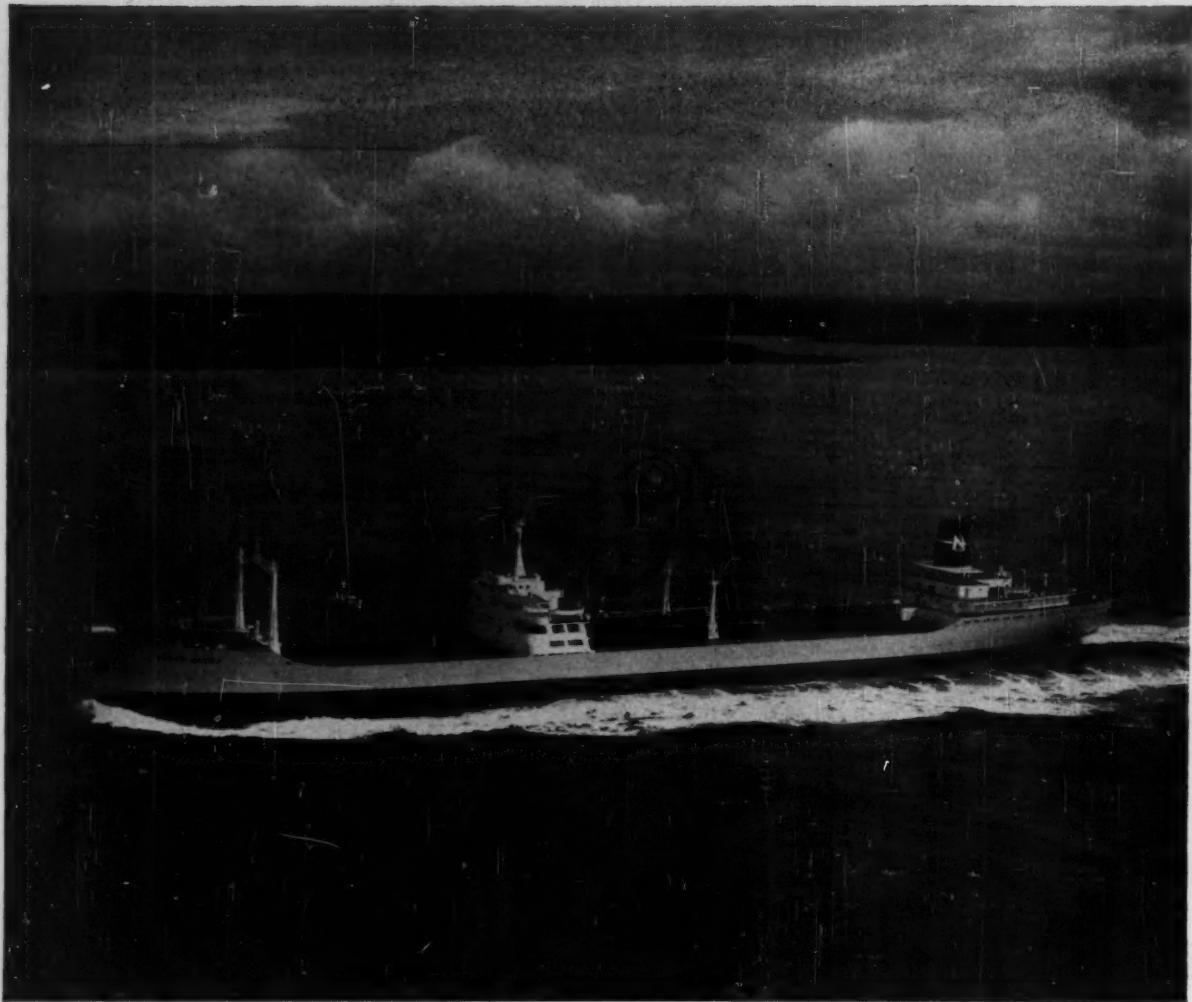
### Southwestern Engineering Company

Engineers and Constructors  
...Manufacturers  
Serving the process industries

4800 Santa Fe Avenue  
Los Angeles 58, Calif., Dept. CE-15  
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#### SWECO PRODUCTS

Heat Exchangers  
Custom fabrication of  
all types of steel, aluminum  
and special alloy vessels for  
the process industries  
Screen Separators



The *World Glory* on her sea trials

## WORTHY OF HER NAME

The 45,500-ton S.S. *World Glory*, designed and constructed by Bethlehem for Stavros S. Niarchos, is the largest tanker ever built in the United States. But size is only one of her attributes. Incorporated into her design are a number of refinements that endow her with an unusual degree of operating efficiency and economy.

She revealed some of these qualities during her sea trials. Ballasted to service draft, the 736-ft tanker maintained speeds of better than 17 knots at her designed maximum of 15,000 shaft horsepower and of better than 16 knots at 12,000 shp.

*Shipping men the world over will recognize this as a remarkable demonstration of speed in relation to horsepower and tonnage.*

Many factors contributed to this outstanding performance. But chief among them was the vessel's improved hull form. Developed by Bethlehem, this form was designed to provide the tanker with maximum propulsive efficiency.

Truly, the *World Glory* is fully worthy of her name . . . and is another example of Bethlehem's contributions to shipbuilding progress over half a century of service to the maritime industry at home and abroad.

**SHIP REPAIR YARDS**  
Boston Harbor      New York Harbor  
Baltimore Harbor      Beaumont, Texas  
Los Angeles Harbor      San Francisco Harbor

**SHIPBUILDING YARDS**  
Quincy, Mass.      Staten Island, N.Y.  
Sparrows Point, Md.      Beaumont, Texas  
Terminal Island, Calif.      San Francisco, Calif.

## BETHLEHEM STEEL

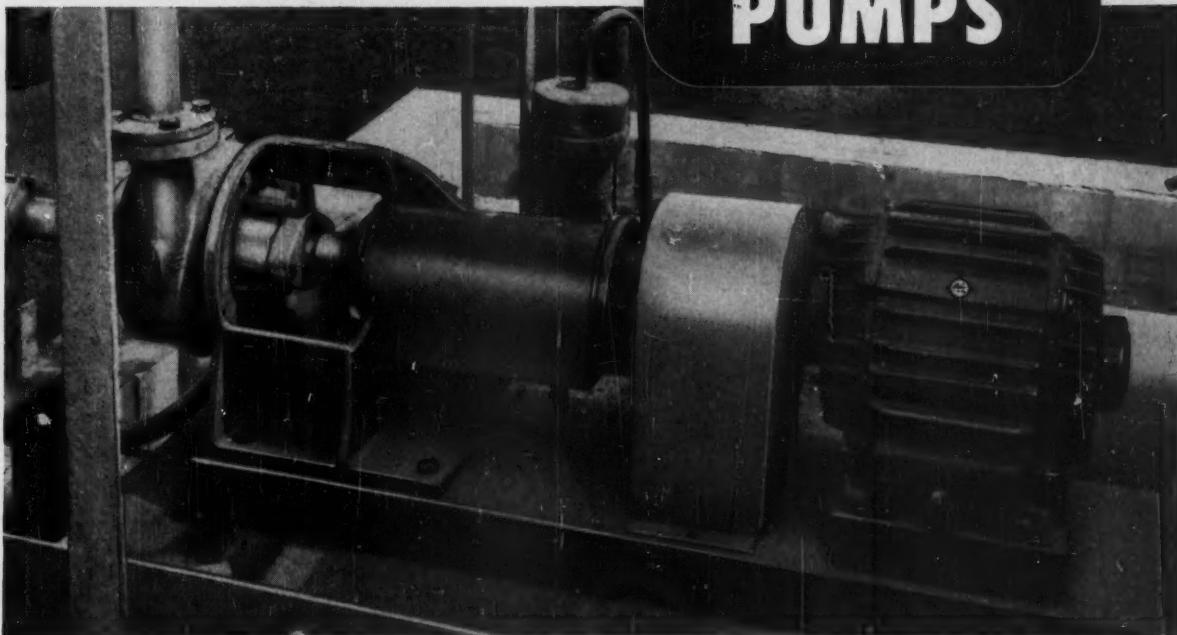
### Shipbuilding Division

GENERAL OFFICES: 25 BROADWAY, NEW YORK 4, N.Y.

On the Pacific Coast shipbuilding and ship repairing are performed by the Shipbuilding Division of Bethlehem Pacific Coast Steel Corporation



# Save Hundreds of Dollars on Many Process Pump Applications



This pump will do many of the jobs of a costly refinery-type pump, yet it costs hundreds of dollars less to buy.

It isn't meant to do every job in the chemical industry. But it will handle a big percentage of the jobs. Check the construction and design features that make this possible:

- It's built in most used ratings . . . to 3500 gpm, heads up to 550 ft.
- Handles liquids in most common temperature range . . . up to 550 F.
- Pumps liquors, corrosive materials and solutions, and petroleum products.

- Built in wide choice of materials including: iron, bronze, aluminum bronze, stainless steel, high nickel alloys and others.

- Available with several sealing methods including standard packing, inside and outside mechanical seals, plus special features such as cooling water jacket, smothering gland and others.

- Features double-row, oil-lubricated bearings. Two oil rings running in generous reservoir of oil carry oil to bearings.

- Rigid cast-iron frame supports pump body and holds bearings in alignment.

*Get complete information. Call your nearby Allis-Chalmers district office. Or write to Allis-Chalmers, Milwaukee 1, Wisconsin. Ask for Bulletin 52B7638.*

A-4527

## ALLIS-CHALMERS



**different types of  
TRI-CLOVER fittings  
used to solve specific  
Corrosion-Resistant  
piping problems for  
ELI LILLY & COMPANY**



Eli Lilly's modern, efficient pharmaceutical plant at Indianapolis serves as an excellent example of the way in which some of the many types of Tri-Clover Stainless Steel Fittings are utilized to solve specific corrosion-resistant liquid conveying line problems.

With Tri-Clover and Eli Lilly engineers working together, the most efficient, economical type of fitting and line assembly was determined to meet each individual process requirement.

With a complete line of all types of highest quality stainless steel fittings, valves, pumps and tubing, plus experienced engineering service, Tri-Clover is extremely well qualified to help you solve your corrosion-resistant piping problems.

Call or write for further details.

See your nearest  
**TRI-CLOVER DISTRIBUTOR**

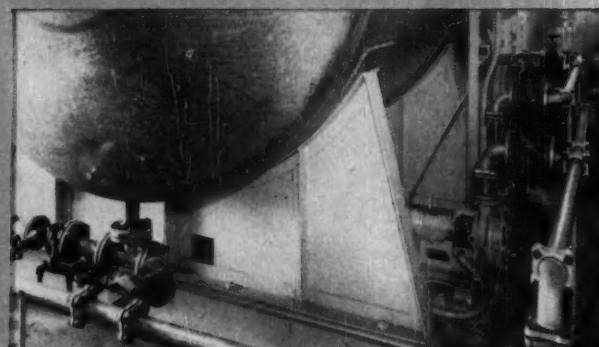
**LADISH CO.**  
*Tri-Clover Division*  
KENOSHA WISCONSIN



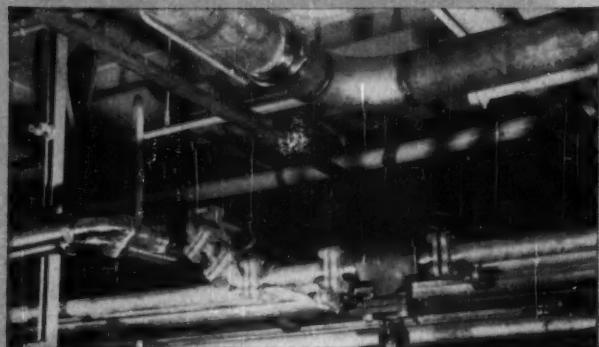
THE Complete LINE



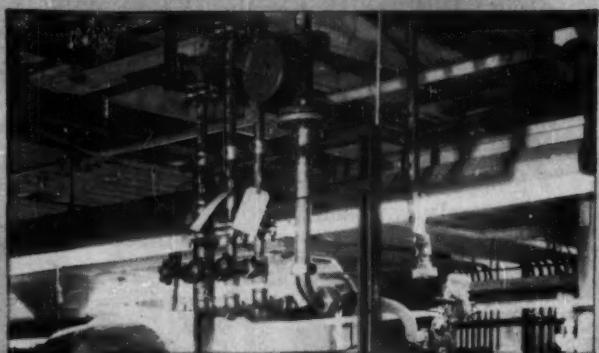
**1** Polished sanitary type stainless steel fittings are used here in liquid transfer lines to a filling machine.



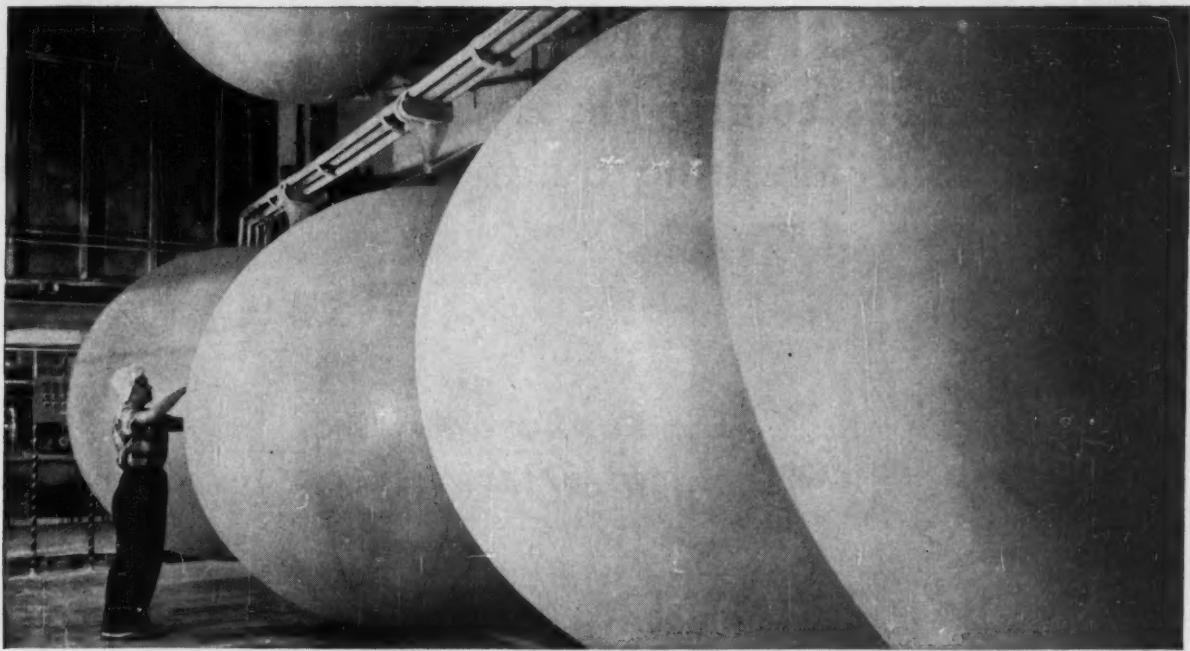
**2** Tri-Clover stainless steel conical end fittings are used here in processing Pyrogen-free distilled water.



**3** View shows Tri-Clover conical end, sanitary, industrial welding and Tri-Clamp fittings utilized in several different liquid transfer lines.



**4** Here are liquid conveying lines to filling machines, utilizing Tri-Clover conical end, sanitary, and I.P.S. screwed stainless steel fittings.



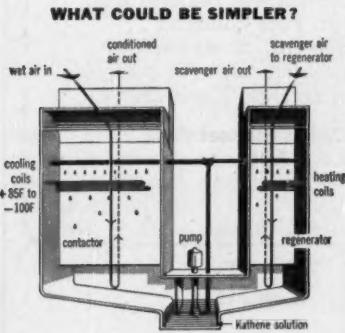
**WEATHER BALLOON  
MAKER SAVES  
\$2500 A YEAR WITH  
KATHABAR EQUIPMENT**

Kathabar humidity conditioning provides the right weather for making weather balloons. The Dewey and Almy Chemical Company obtains 40-grain air without frost, expensive over-cooling and re-heating, or duplicate coils. The system's coolant is 75°F water. *Results:* annual saving of \$2500 in operating costs—and faster production of their balloons.

Here's how their two-zone system works. In the first zone, ground level, latex balloon gels are inflated from one-fourth to full size. Moisture between latex particles is a necessary lubricant during gel inflation. The maintained air conditions average 70°F, 50% RH.

Second zone, an 80-foot drying tower, is held at 100°F and 20-30% RH for final drying. The moisture must be removed at a controlled rate—not too fast or the balloons rupture; not too slow or production is impeded. Temperatures over 100°F would cause a spotty pre-cure.

This is a typical example of how Kathabar humidity conditioning has solved industrial air conditioning problems for 20 years. Your Kathabar system representative can show you how to dictate *your* production weather. As a trial balloon, write for Literature Group K54-2.



Air to be conditioned passes through the contactor, where an absorbent solution removes moisture (the amount depends on the automatically-controlled temperature of the solution). In the automatic regeneration, about 15% of the solution is heated, and the moisture it releases is blown out the window.



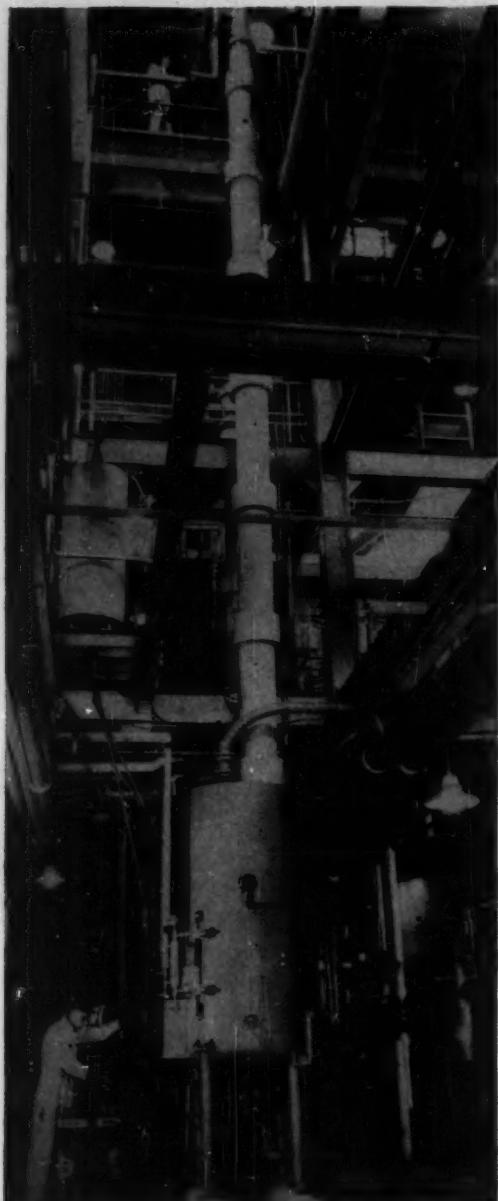
**SURFACE COMBUSTION CORPORATION • TOLEDO 1, OHIO**

ALSO MAKERS OF **Surface** INDUSTRIAL FURNACES

**Janitrol** AUTOMATIC SPACE HEATING

# DOW CORNING

increases column throughput  
without impairing overhead purity



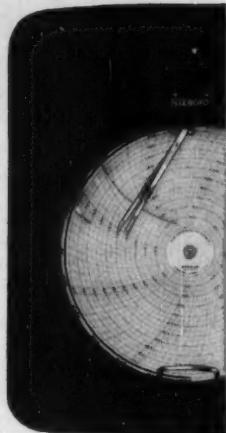
Heat input to the still of this vacuum packed fractionating column in Dow Corning pilot plant is under precise Foxboro Control. Based on pressure drop across column, Foxboro Control maintains optimum conditions at all times. See diagram.

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

**FOXBORO**  
Reg. U.S. Pat. Off.

automatic control for  
fractionating column pressure-drop

...with  
**Foxboro Control**  
of pressure drop →

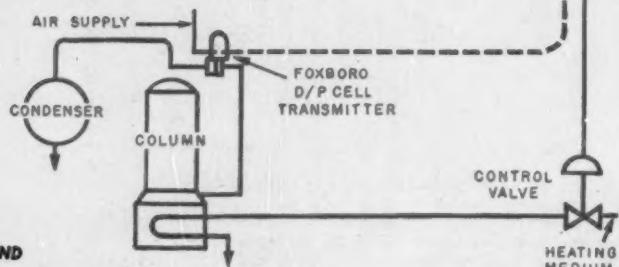


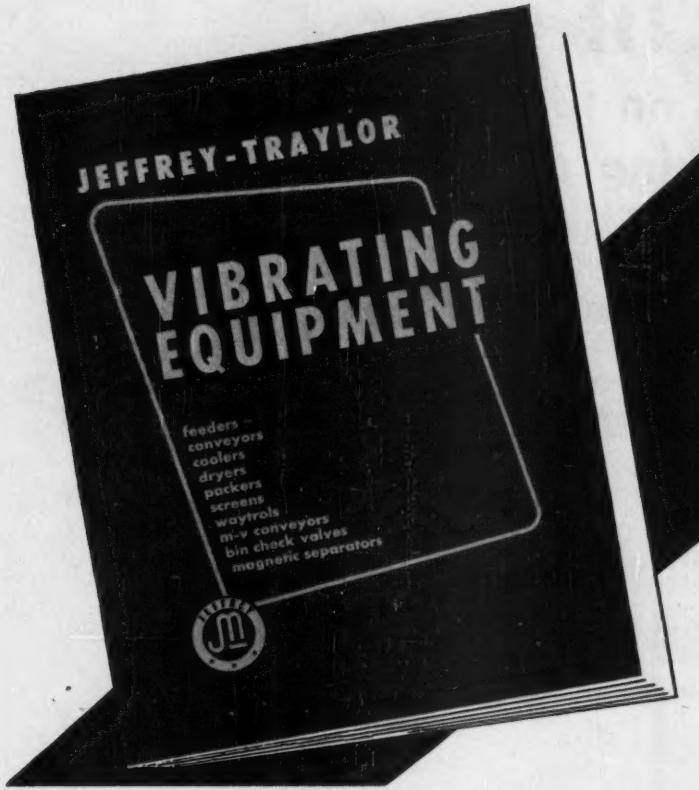
Maximum column loading with minimum priming or carry-over is one outstanding efficiency feature of Dow Corning Corporation's pilot plant production of chlorosilanes and silicones at Midland, Mich. To achieve this optimum throughput, completely unaffected by variations in product concentration, Dow chemists employed the Foxboro Pressure Drop Method of Control.

In this automatic Foxboro System, a d/p Cell Transmitter continuously measures column pressure loss caused by plate or packing resistance plus liquid and vapor mass velocities. This true measure of vapor product movement is relayed by the transmitter to a Foxboro M/40 Controller. The Controller precisely regulates heat input to the column . . . maintains steady boil-up for any given feed stock, without overloading.

Foxboro Pressure Drop Control will perform with the same high-efficiency on your column . . . whether it's packed, bubble cap, or sieve-plate type . . . on continuous or batch runs. For complete details, write for Engineering Data Sheet 282-14.

The Foxboro Company, 361 Neponset Ave.,  
Foxboro, Massachusetts, U.S.A.





## **NEW 232 page catalog of valuable data on Vibrating Equipment**

**... send for it**

Our Jeffrey-Traylor Sales Division has come up with a most complete and concise reference book covering electric and mechanical vibrating equipment, and magnetic separators. All under one cover.

You'll like this new catalog for it not only displays outline views of each unit but shows many installations with applications under almost every known condition using an unlimited assortment of materials. It includes also drawings in detail; tables with sizes, dimensions, power and weights; control equipment; principles of design and operation, etc.

Ask us for a copy of Catalog No. 870 — you'll be glad you did.

**THE JEFFREY MANUFACTURING CO.**  
909 North Fourth Street, Columbus 16, Ohio

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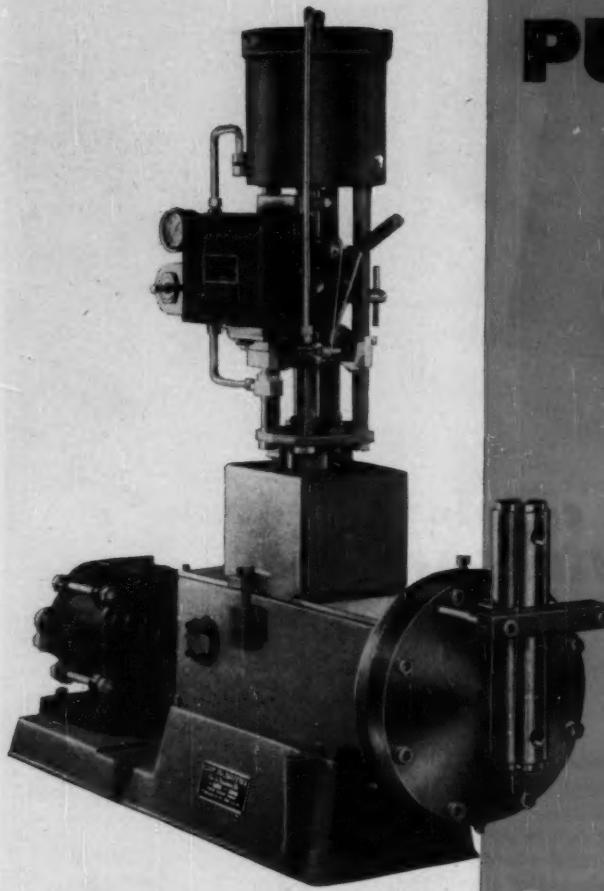
NAME \_\_\_\_\_ POSITION \_\_\_\_\_

COMPANY \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_



# NOW!!



## TWO PUMPS IN ONE!

Lapp Pulsafeeder is the combination piston-diaphragm pump for controlled-volume pumping of fluids. Reciprocating piston action provides positive displacement. But the piston pumps only an hydraulic medium, working against a diaphragm. A floating, balanced partition, the diaphragm isolates chemical being pumped from working pump parts—eliminates need for stuffing box or running seal. Constant pumping speed; variable flow results from variation in piston-stroke length—controlled by hand-wheel, or, in Auto-Pneumatic models, by instrument air pressure responding to any instrument-measurable processing variable.

## Lapp Auto-Pneumatic **PULSAFEEDER**

**OPERATES  
AT FULL CAPACITY  
AND FULL RATED  
PRESSURE**

The Lapp Auto-Pneumatic Pulsafeeder has made possible automatic continuous processing in many processes involving chemicals or mixtures which have not been satisfactorily handled by pumps of conventional construction. In this construction, pumping rate is controlled by instrument air pressure responsive to variable flow, pH, temperature, liquid level, pressure, or any other instrument-measurable processing variable. And now, new improved Auto-Pneumatic instrumentation provides for greater capacity and/or pressure—full ratings as listed for manually-controlled models.

*WRITE FOR BULLETIN 440 with typical applications, flow charts, description and specifications of models of various capacities and constructions. Inquiry Data Sheet included from which we can make specific engineering recommendation for your processing requirement. Write Lapp Insulator Co., Inc., Process Equipment Div., 348 Wilson St., Le Roy, N.Y.*



## How to Select an Economical Temperature Regulator

First of all, what does economy mean where temperature regulators are concerned? In some industries it means improvement of product or reduction of spoilage through closer control of process temperatures. In others, it means the paring down of operating expense. The price of the regulator itself is a relatively small factor.

Today's buyers are shopping for:

1. Accuracy of control — not only when the regulator is new, but throughout its service life
2. Dependability — to prevent loss of production time
3. Minimum installation and maintenance cost

Here are a few tips on what to look for when you're installing a new or replacing an old temperature regulator —

**Packless construction . . .** and for this reason: A diaphragm operated, packless regulator minimizes friction. There are no closely fitted parts to stick or bind

because of uneven expansion or collection of foreign matter. Also, there's less maintenance, since no repacking is ever required.

**A guarantee against wire drawing** of the seats and discs. Insist on it. This guarantee in combination with single seat design assures you of tight shutoff; you avoid expensive steam losses as well as loss of product in a process application.

**Broad control range.** In a standard regulator you should expect a control range of 100 F. And make sure the unit you select has a vapor tension thermostat that can take over-temperatures of at least 100 F.

**Easy maintenance.** Why ask for grief? Your temperature regulator should be basically simple in design so that it can be serviced by average plant personnel. All parts should be readily accessible for testing and cleaning.

**Double duty.** There's no point in buy-

ing a separate pressure regulator when you can select a temperature regulator that combines both temperature and pressure control within the same unit.

**Self-operating.** Make sure you get a regulator that operates on its own initial pressure. By doing so, you avoid the purchasing and maintenance of an air compressor plus air piping, and you're sure of uninterrupted operation during electric power failures.

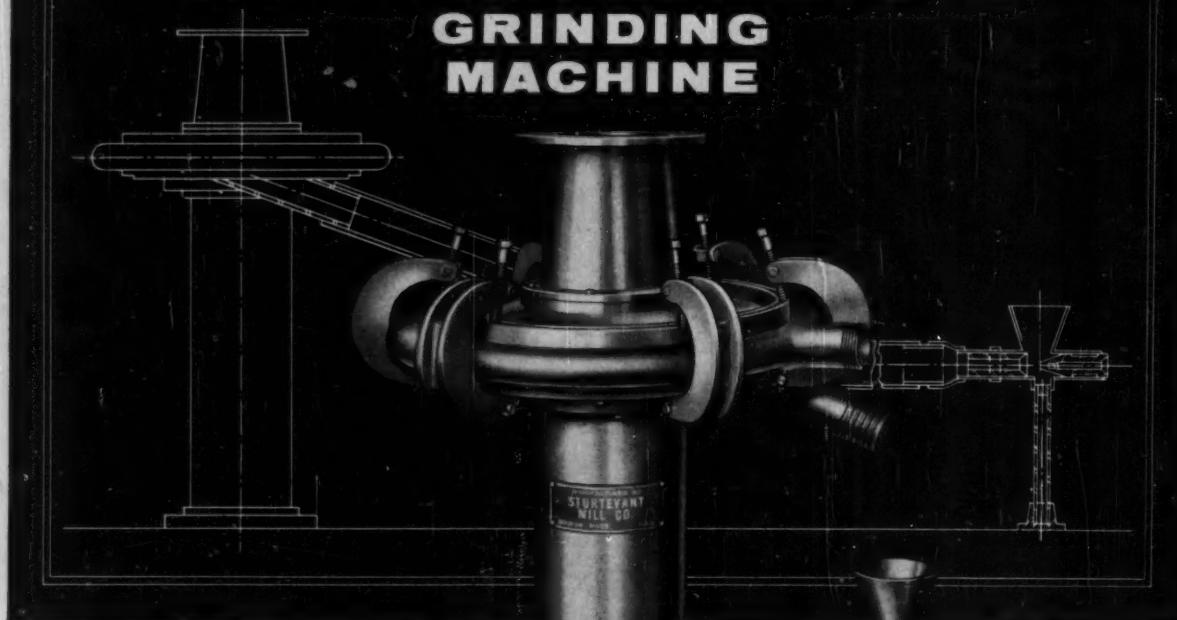
• • • •  
All of these points are important to you when it comes to selecting an economical temperature regulator. Perhaps you didn't realize you could expect so much. And perhaps you didn't realize that Spence Temperature Regulators offer all these features and more. May we send you our Bulletin T 500 containing further details?

SE 136

SPENCE ENGINEERING COMPANY, INC.

Walden, New York

**STURTEVANT**  
**MICRONIZER®\***  
**GRINDING**  
**MACHINE**



**Grinds Materials  
To Any Micron Size  
Specification**

**NOW AVAILABLE FOR  
OUTRIGHT SALE**

The Sturtevant *Micronizers* are fluid jet grinding machines designed to reduce solid materials to particle sizes in the micron range.

Using compressible fluids, air or steam, as the source of energy, *Micronizers* produce pulverized materials to specifications unobtainable by other mechanical equipment such as ball, pebble or hammer mills.

The variety of materials processed is large and includes both nonmetallic and metallic minerals and ores, metals, pigments, insecticides, fungicides, pharmaceuticals, plastics, dyes and numerous other organic and inorganic products.

It is quickly and easily cleaned on changes of formulation with minimum loss of material. Simple to install and operate. It is available as a machine alone . . . or as a complete grouping with pre-mixing, grinding and bagging equipment. Write for complete information, today.

\*Micronizer is the Registered Trademark of the Sturtevant Mill Company.



**STURTEVANT MILL COMPANY**

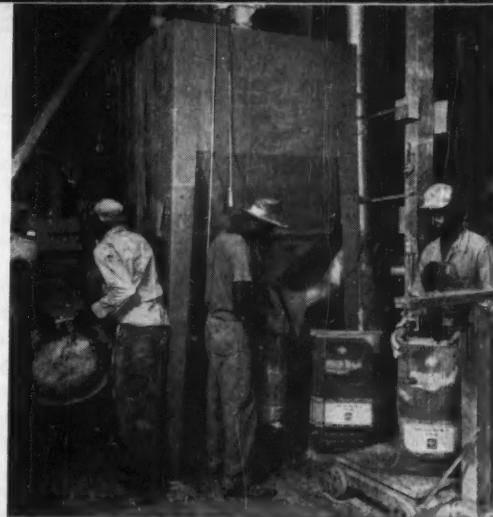
100 CLAYTON STREET, BOSTON 22, MASS.

**Designers and Manufacturers of CRUSHERS • GRINDERS • SEPARATORS • CONVEYORS  
MECHANICAL DENS and EXCAVATORS • ELEVATORS • MIXERS**

How Cotton States Chemical Company  
lifted the blackout on production problems

with **DUSTUBE**<sup>®</sup> collectors

A curtain of chemical dust blacks out a portion of production profits by permitting the escape of valuable material. Cotton States Chemical Co. lifted this curtain through the use of 3 Wheelabrator Dustube Collectors in the manufacture of agricultural chemicals. One ventilates blenders and "sack-off" stations. Another ventilates a mill that grinds Benzene Hexachloride and DDT. A third handles exhaust air from a cyclone which ventilates a mill that grinds concentrates such as Aldrin and Toxaphene. Cotton States estimates recovery of at least \$65 worth of material a day, a potential annual saving of more than \$16,000. Lift the blackout on your production profits. Investigate Dustube for your plant today. Write now for Bulletin No. 372.

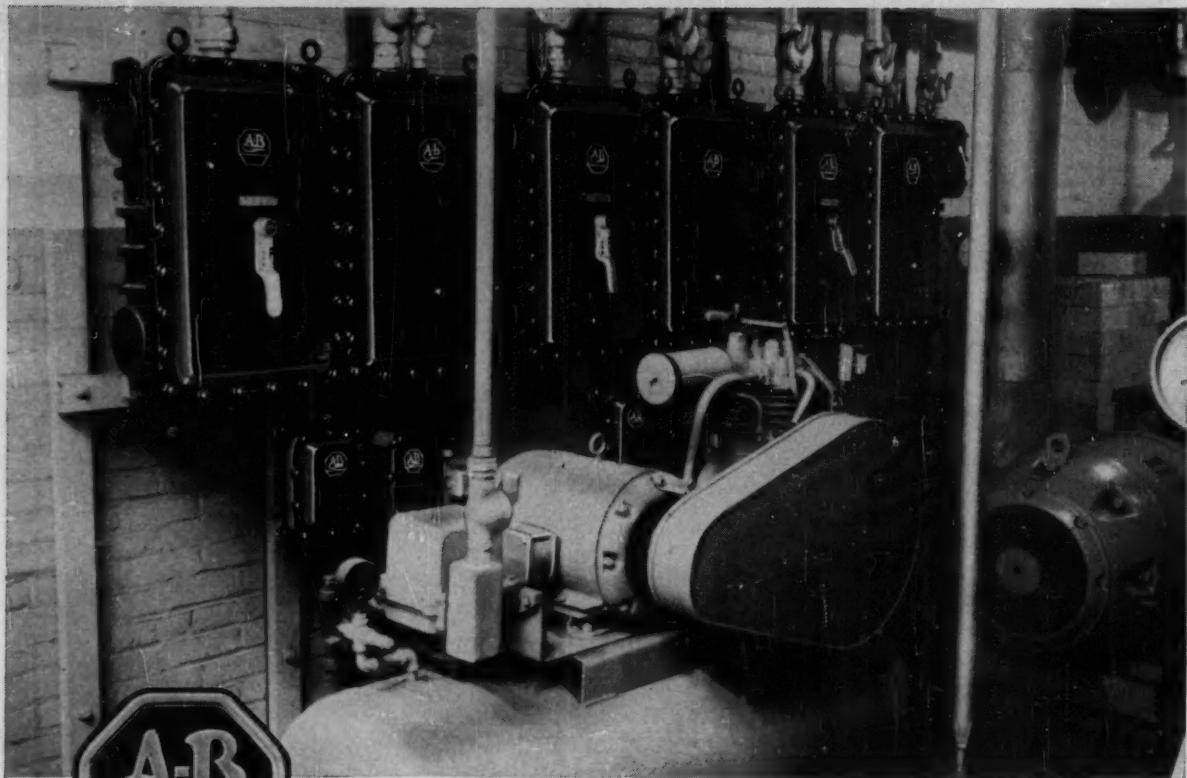


American  
**WHEELABRATOR**<sup>®</sup>

trail blazer of industrial progress

AMERICAN WHEELABRATOR & EQUIPMENT CORP., 347 S. Byrkit St., Mishawaka, Indiana

CHEMICAL ENGINEERING—January 1955



The Sign of  
**QUALITY**  
MOTOR CONTROL



Bulletin 713  
Circuit Breaker  
Type Combination  
Starter in NEMA  
7 Enclosure.



Bulletin 709  
Solenoid Starter  
in NEMA 7  
Enclosure.



Bulletin 712 Com-  
bination Starter  
with Disconnect  
Switch in the NEMA  
Type 4 watertight  
and weatherproof  
enclosure. Rubber  
gasket seal.

Reliable overload  
protection provided  
by all A-B starters.

## SAFE PLANT OPERATION with SAFE MOTOR STARTERS

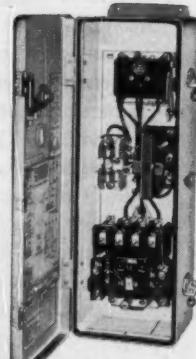
In this antibiotics plant, motor starters with NEMA Type 7 explosion proof enclosures were necessary to satisfy the fire code. Such cast iron enclosures have wide machined flanges and many bolts to assure a gastight seal.

Because all Allen-Bradley solenoid motor starters use double break, silver alloy contacts—which are always in good operating condition—frequent inspection is unnecessary. Only one moving part assures trouble free operation.

It costs time and money to "open" bolted enclosures. So, install Allen-Bradley starters—and forget them. You'll be "safe" with only a rare inspection. Let us send you a copy of the 6th Edition of the A-B Handy Catalog.

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Bulletin 712 Automatic Com-  
bination Starter in a NEMA  
Type 12 enclosure for pro-  
tection against dirt and oil.

**ALLEN-BRADLEY**  
**SOLENOID MOTOR CONTROL**

QUALITY



*Only a thorough evaluation can give you the full scope of the Pluronics' benefits. Pictured here is a test to determine the cloud point of nonionic surfactants, and a check on the melting point of Pluronic F-68 . . . first 100%-active nonionic commercially available in flake, powder or solid form.*

## Report on Wyandotte Pluronics\*

### What's new about the Pluronics?

The Pluronics are a new series of 100%-active nonionic surface-active agents, based on a chemical concept not previously used in the synthesis of nonionic surfactants. They provide an over-all balance of desirable properties: ease of formulation, stability, controlled sudsing, a range of surface-active properties, low hygroscopicity, dedusting properties, and a low order of toxicity.

The unusual flexibility of the Pluronics make them especially interesting . . . it is possible to prepare a Pluronic to meet any requirement of molecular weight or hydrophilic-hydrophobic balance, within the established range.

### What's different about them?

The Pluronics are the first commercial example of a block-polymer-type surface-active agent . . . made from a hydrophobic polyoxypropylene base with hydrophilic polyoxyethylene groups attached to either end. This use of polyoxypropylene as the hydrophobic portion of the molecule is unique, the secret being to build a polyoxypropylene chain long enough to be water insoluble. The hydrophobic base may be varied in molecular weight, and any percentage of the hydrophilic groups can be added. The Pluronics range in molecular weight from 1800 to 8000. This compares with the usual range in molecular weight for surface-active agents of from 300 to 700.

(CONTINUED ON NEXT PAGE)

\*REG. U.S. PAT. OFF.

## What about formulating?

Pluronics are easy to formulate . . . you can choose from liquid, paste, flake, powder or solid-cast. Liquid Pluronics can be spray-blended by special spray systems, an ordinary sprinkling can, or nail-punctured drums suspended above mixing apparatus. Pluronics blend easily with common builders; permit you to compound a quality product using only solid materials.

## Where are Pluronics used?

The Pluronics are already in commercial use in water conditioning, in the manufacture of viscose rayon and cellophane, in dye leveling, shampoos, boiler-water compounds, mechanical-dishwashing compounds, home and laundry detergents, and in metal-cleaning formulations. Promising new applications are being reported continually. The Pluronics have a wide range of characteristics. For example, L62 is a good wetting agent . . . F68 is an excellent dispersing agent . . . L64 combines a balance of wetting, dispersing and emulsifying characteristics that make it exceptionally effective as a detergent. These characteristics give the Pluronics unique advantages over other surface-active agents. They merit your full and careful evaluation. Brief summaries of a few of their uses are given here.

\* \* \*

## Flexibility of Pluronics helpful in metal cleaning

The field of metal cleaning is unusually complex, due to the many variables in the type of cleaning, the types of metals to be cleaned, types of soil to be removed, and the processing that metals are to receive after cleaning. Most metal-cleaning operations, therefore, require a cleaning compound designed to fit the particular process.

The Pluronics have proved especially valuable in metal-cleaning formulations for a number of reasons.

Most important, perhaps, is their exceptional flexibility. With the Pluronics, you can tailor the product to meet your precise needs.

The Pluronics are stable and effective over the entire range of pH, in both acid and alkaline solutions. The suds range of the Pluronics is wide — from no foam to moderate foam. You can choose a Pluronic, or combination of the Pluronics, with the exact sudsing characteristics you require. Another important benefit: in electrocleaning, the controlled sudsing properties of the Pluronics preclude excessive hydrogen entrapment and reduce explosion hazards.

Test the Pluronics thoroughly . . . use the coupon for more information.

## The Pluronics control suds in laundry detergents

Large-scale makers of laundry detergents have recently introduced compounds containing one or more of the Pluronics. Why? Because they found that the Pluronics, with their over-all balance of desirable properties, are the most versatile agents of their type available today.

Some of these properties are: controlled sudsing, ease of formulation, stability in solution, compatibility with a wide variety of materials, high detergency, and permanent dedusting effect with no moisture pickup.

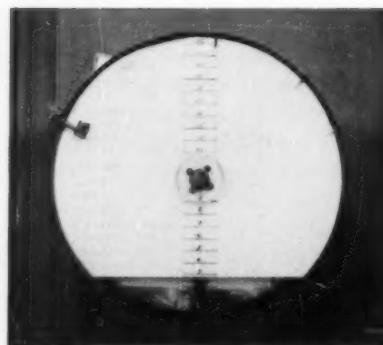
Pluronics' inherent flexibility makes it easy to formulate compounds with optimum characteristics. Suds level, carbon soil removal and whiteness retention can be varied easily to suit particular requirements.

Perhaps the Pluronics could give your product the same market advantage. Why not investigate today?

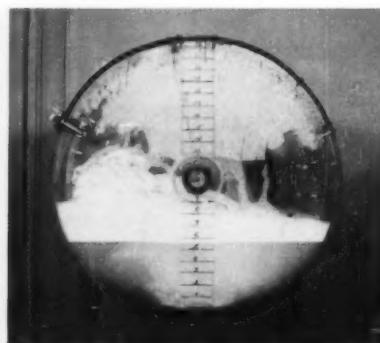
## Pluronics important in water treatment

Commercial usage by major producers of boiler-water compounds has proved the Pluronics to be one of the most valuable recent developments in the industry.

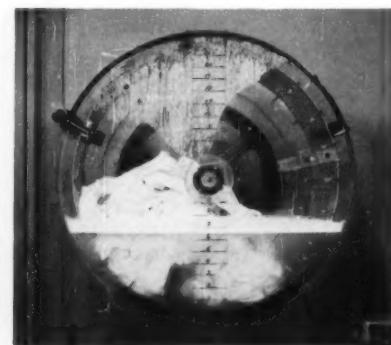
### Compare suds levels of home detergents



High-sudsing property of typical popular detergent.



Action of low- or "controlled-sudsing" popular detergent.



Very low sudsing of new detergent containing Pluronics.

There are two main reasons for this: 1) their foam depressing characteristics, and 2) their exceptionally effective dispersing power for calcium and magnesium salts. Other properties of the Pluronics that have proved beneficial in boiler-water treatment, as well as in some water-conditioning applications, are: their compatibility and stability with acid or alkali solutions over a wide temperature range, and their unusually low order of toxicity.

Are these *your* requirements for a surface-active agent? . . . for more information, use coupon below.

## **Pluronics improve mechanical-dishwashing compounds**

Nowhere have the Pluronics played a more dramatic role than in the mechanical-dishwashing field. Here they found an almost immediate acceptance, due to their unique combination of desirable properties. The most important are:

1. An ability to eliminate staining and streaking usually caused by improper rinsing.
2. Exceptional low-foaming properties.
3. Better, more permanent dedusting effect than other surface-active agents.
4. No increase in the hygroscopicity of the compound.

No other single nonionic surfactant can duplicate this unique combination of desirable properties. Formulators using the Pluronics in their mechanical-dishwashing compounds have a distinct product advantage — a product advantage that pays off in a distinct sales advantage.

If you manufacture mechanical-dishwashing products, you should investigate the Pluronics thoroughly . . . use coupon below for further information.

## **What about stability?**

The Pluronics are stable in both acid and alkaline solutions, even at elevated temperatures. Moreover, their surface-active properties remain relatively constant over the entire range of pH. Since the Pluronics are not precipitated by calcium or magnesium ions, their detergency performance in formulated products remains relatively uniform, regardless of the water hardness.

## **What about sudsing?**

The Pluronics series offers a wide range of foaming properties, enabling you to choose a particular Pluronic with exactly the sudsing characteristics you require. Pluronics L61 and L62 are essentially non-foaming, generating less foam than any other commercially available surfactant.

Pluronics L64 and L68 generate moderate foams, making them particularly useful in those applications where foam is desirable.

Pluronic L61 can be used effectively to depress the foam of any of the other Pluronics.

## **What about dispersing power?**

Pluronic F68 and Pluronic L64 are exceptionally effective dispersing agents for calcium and magnesium salts. The Pluronics, by keeping these inorganic salts in suspension, reduce the amount of adherent hard water deposits in boilers and pipes when used in water-treating compounds. The use of the Pluronics also renders the scale that does precipitate softer and more easily removed, due to the Pluronics' rewetting effect.

(CONTINUED ON NEXT PAGE)

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PERMIT NO. 1  
(Sec. 34.9, P.L.&R.)  
**Wyandotte, Michigan**

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No postage stamp necessary if mailed in the United States

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**Wyandotte Chemicals Corporation**

**Attention: Advertising Dept.**

**Wyandotte, Michigan**



## What about rinsability?

The Pluronics provide maximum effectiveness as rinsing agents, in proportions as low as 2%. Laboratory evaluations, field tests and established commercial usage have shown the Pluronics to be superior in the promotion of free-rinsing — especially valuable in the mechanical-dishwashing field.

Staining and streaking due to improper rinsing have been decreased by as much as 90% by the inclusion of a very small amount of the Pluronics in mechanical-dishwashing compounds.

## What about dedusting?

The dedusting effect of the Pluronics is much more permanent than that of many other surface-active agents, yet products incorporating the Pluronics remain free-flowing.

The liquid Pluronics, even at concentrations as low as 0.5% by dry weight of the formulation, are effective dedusting agents. They dedust not only during the compounding operations themselves, but also the finished product.

Compounders report that many dedusting agents lose their effectiveness after a period of time, whereas the use of half as much Pluronics gives effective permanent dedusting. This superiority is believed to be due to the much higher molecular weight of the Pluronics. They have no tendency to migrate.

## What about hygroscopicity?

One of the problems of using anionic surface-active agents is the rapid increase of hygroscopicity in pro-

portion to active-agent content. This hygroscopicity is also quite apparent in many of the nonionics.

An unusual feature of the Pluronics is their low order of hygroscopicity. Not only are the Pluronics relatively nonhygroscopic themselves, but they actually decrease the hygroscopicity of other components of formulations in which they are used.

## For samples and more information . . .

The Pluronics make it easy to formulate products with optimum characteristics, products that are completely dust-free, non-caking, and exceptionally free-flowing, products with distinct advantages over competition. Evaluate them as a basis for an entirely new approach in formulating . . . the Pluronics may be the key to compounding concepts that open up new avenues of progress for your company. *But only a thorough evaluation can give you the full scope of the Pluronics' benefits.* For samples of the Pluronics, data sheets summarizing their physical and surface-active properties, and other technical and price information — call your Wyandotte representative or mail the coupon today. *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Offices in principal cities.*



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cols • Chlorinated Solvents • Synthetic Detergents • Agricul-  
tural Insecticides • Other Organic and Inorganic Chemicals

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### Wyandotte Chemicals Corporation, Wyandotte, Michigan

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- Data on the use of Pluronics in metal-cleaning formulations
- Samples of Pluronics L61, 62, 64, F68 for metal-cleaning products
- Data on the use of Pluronics in home and commercial laundry detergents
- Samples of Pluronics L44, 61, 62, 64, P75, F68 for laundry detergents
- Data on the use of Pluronics in water-treating applications
- Samples of Pluronics L61, 64, F68 for water-conditioning compounds
- Data on the use of Pluronics in mechanical-dishwashing compounds

Samples of Pluronics L61, 62, F68 for dishwashing products

Have a Wyandotte representative call on me.

Data on Pluronics for \_\_\_\_\_

\_\_\_\_\_ application

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Firm \_\_\_\_\_ Title \_\_\_\_\_

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**Capital Spending Plans for 1955 . . .**

# Here is Good News About Business Prospects

In 1955, American industry is now planning to spend within 5 per cent of the amount it is spending this year on new plant and equipment. This is the tensely awaited result of a check-up just completed by the McGraw-Hill Department of Economics.

Hundreds of companies, by far the largest number in the eight-year history of these McGraw-Hill surveys, cooperated in the check-up. Combined, they represent 29 per cent of all industrial employment and over 60 per cent of employment in the industries where capital investment is highest. Such a broad cross section constitutes

a reliable gauge of the plans of industry as a whole.

What is the meaning of these plans, detailed by the table below, for capital investment next year? Is it good or bad news, so far as it concerns the prospect of continuing prosperity? It is to this crucial question that this editorial is addressed.

## Key to Prosperity

**It is not only good but very important business news that American industry plans to spend in 1955 almost as much for new plant and equipment as it is spending this year.** The reason it is important is that a high level of activity in the capital goods industries is universally recognized as a particularly potent ingredient of prosperity for the nation as a whole. A dollar spent for capital goods is spent again and again for wages and materials. Its stimulating effects, called by economists multiplying effects, move through the economy in much the same way that a pebble tossed into a pond creates a widening circle of ripples. This is one reason why there is such intense business interest in the surveys of plans for capital investment.

Here are the principal reasons why the results of the McGraw-Hill survey are a good omen for continuing prosperity:

### PLANS FOR CAPITAL INVESTMENT

|  | MILLIONS OF DOLLARS |                    |                 | Percent<br>Change<br>1954-<br>1955 |
|--|---------------------|--------------------|-----------------|------------------------------------|
|  | 1953<br>ACTUAL*     | 1954<br>ESTIMATED* | 1955<br>PLANNED |                                    |
| All Manufacturing                          | \$10,026            | \$ 9,249           | \$ 8,598        | -7%                                |
| Petroleum Industry†                        | 4,600               | 4,875              | 4,920           | +1                                 |
| Mining                                     | 506                 | 380                | 311             | -18                                |
| Railroads                                  | 1,312               | 851                | 769             | -10                                |
| Other Transportation<br>and Communications | 2,954               | 2,922              | 2,640           | -10                                |
| Electric and Gas<br>Utilities              | 4,548               | 4,274              | 4,206           | -2                                 |
| ALL INDUSTRY                               | 23,271              | 21,784             | 20,727          | -5                                 |

\*United States Department of Commerce; Chase National Bank; McGraw-Hill Department of Economics

†Petroleum refining, included under both "All Manufacturing" and "Petroleum Industry," is included only once in the total

**1. American industry is demonstrating that it does not need the stimulus of war-created shortages, or a rearmament boom, in order to maintain a very high level of capital investment.**

The slight decrease now planned for 1955 will still maintain a level only about 11 percent below the all-time peak attained in 1953 under the stimulus of a defense expansion boom.

**2. Capital investment promises not merely to stabilize at a high level, but actually to increase as 1955 goes on and thus give renewed stimulus to business.**

The level of investment now planned for 1955 by *industry*—manufacturing, petroleum, mining, transportation, communications and utilities—is within 5 per cent of 1954. Contract awards for *commercial construction*—stores, office buildings, warehouses and other service establishments—as compiled by the McGraw-Hill publication *ENGINEERING NEWS-RECORD*, indicate a substantial increase in 1955. Thus total capital expenditures by *all business* may be very close to this year's total.

Actually, in the fourth quarter of 1954, business capital expenditures, as reported to the U.S. Department of Commerce, are down about 2.5 per cent from the average for the year as a whole. So there is a good chance that during 1955 the annual rate of capital investment will rise above this present level.

**Effect of Tax Changes**

The plans reported by the McGraw-Hill survey are preliminary plans, reported at the beginning of the period of business budgeting for 1955. As budgets are completed, new projects may bring the total expenditure that is planned even closer to this year's figure and thus make an even greater contribution to continuing prosperity.

But it also cannot be too strongly emphasized

that these are plans; they are not accomplished investments. As such they have the vulnerability to changed conditions that characterize any plans.

There is some indication in the results of the McGraw-Hill check-up that one change in conditions recently made by the United States government has had an important stimulating effect on plans for business investment next year. It is a liberalization of the allowances for depreciation. Apparently encouraged by this provision, most of the smaller companies are planning to maintain or increase their purchases of new equipment next year, whereas during the past three years their expenditures have been declining. This is obviously a development that strengthens our economy.

A government insensitive to the key importance of capital investment by business, both in providing prosperity and in raising our standard of living, might easily destroy the present plans. One of the easiest and surest means to do this is excessive taxation of business profits which are the key ingredient of business investment. Whether the extraordinarily constructive program recently enacted by the federal government in the field of business taxation can be sustained remains to be seen. **If it can be sustained, the remarkably cheering plans of business for capital investment in 1955 can readily become firm foundations for a continuing prosperity.**

**This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.**

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Donald C. McLean  
**PRESIDENT**

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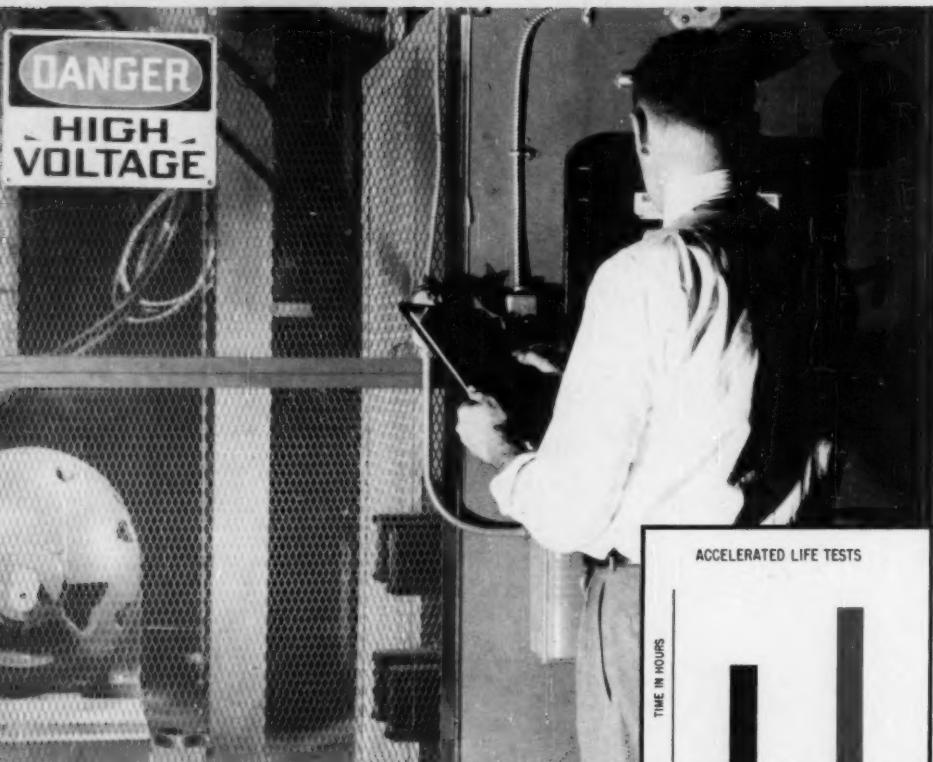
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**HIGH-POTENTIAL TESTS HELP PROVE . . .**

**NEW INSULATION MAKES G-E  
MOTORS LAST 50% LONGER**

**See Details Inside**

# 50% LONGER MOTOR LIFE



FE TEST, General Electric's new Polyex insulation proved that it  
eats aging and mechanical stress. Here is a summary of test results...

An engineering achievement

# General Electric That is

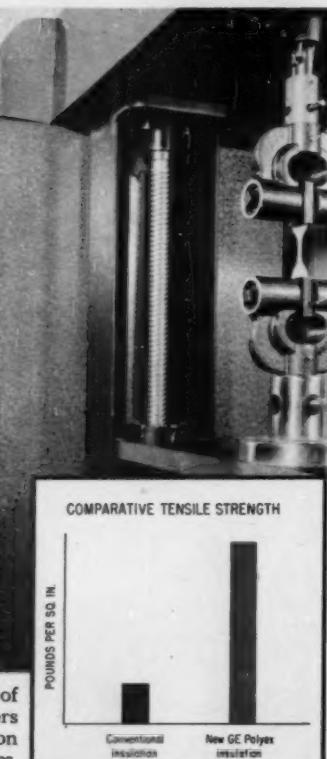
## REVOLUTIONARY POLYEX INSULATION

OF THE AMAZING PROPERTIES OF

General Electric has developed a completely new Class A insulation for form-wound coils which lasts 50% longer than other insulations in use today. Its greater ability to withstand physical and thermal stresses provides an added margin of protection that will mean tremendous savings to you because of reduced motor failure and maintenance costs.

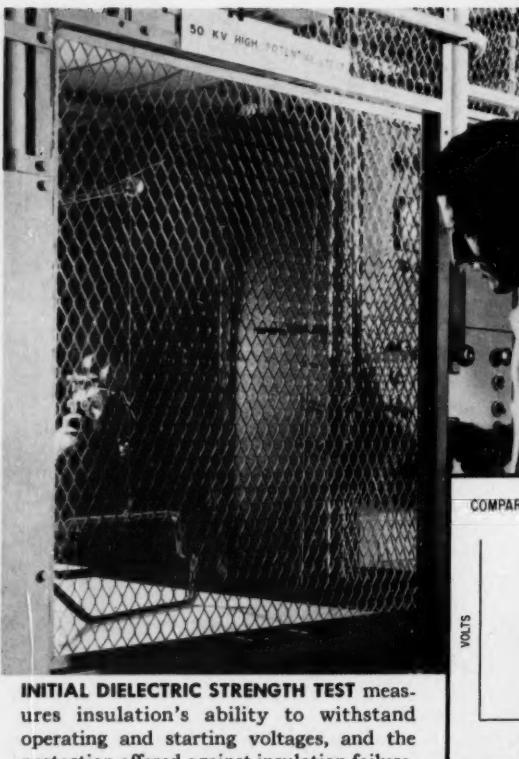
POLYEX INSULATION is a balanced system of polyester films and fibres, together with new hydrocarbon resins. Materials in new Polyex insulation have high dielectric and physical

## TIMES GREATER PHYSICAL STRENGTH



**CUT-THROUGH STRENGTH**, seven times greater than conventional insulation, is another reason for long life.

## 50% MORE DIELECTRIC STRENGTH



**INITIAL DIELECTRIC STRENGTH** measures insulation's ability to withstand operating and starting voltages, and the protection offered against insulation failure.

ment of vital importance to users of motors with form-wound coils . . .

# Electric Develops New Insulation for Motors 7 Times Tougher, Adds 50% to Motor Life

## INSULATION TAKES FULL ADVANTAGE OF NEW POLYESTER FILMS AND FIBRES

strength. For the first time, the cotton and paper-based tapes and sheets in conventional insulations have been eliminated.

**RESULTS OF EXHAUSTIVE TESTS** on new Polyex insulation are summarized on these pages. Insulation qualities like these offer you tremendous savings in motor maintenance and a greater degree of service continuity than ever before possible.

**GENERAL ELECTRIC RESEARCH** for better insulation is a continuing program. Polyex

insulation is the latest result of that program. Three years of intensive development and testing of materials and manufacturing techniques culminated in the most significant advance in large motor insulation in 45 years.

**POLYEX INSULATION IS NOW AVAILABLE** in many ratings of General Electric induction

motors in the range of at no extra cost.

**YOUR G-E SALES** complete information, nearby General Electric **General Electric Company**, New York.

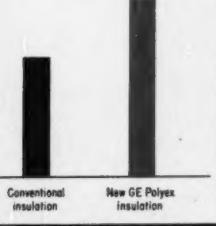
*Progress Is Our Most Important Product*

**GENERAL**  **ELECT**

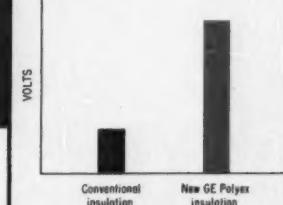
## ELECTRIC STRENGTH, EVEN AFTER HEAT AGING



RELATIVE DIELECTRIC STRENGTH  
(No aging)



COMPARATIVE DIELECTRIC STRENGTH  
AFTER SEVERE AGING AT 125°C



BAKED FOR THOUSANDS OF HOURS at 125°C, Polyex insulation was tested again. It proved that it retains its higher physical and dielectric properties after heat aging.

## CONTAMINANT RESISTANCE



IN SALT SOLUTION, insulation's ability to resist contaminants was tested. Polyex-insulated coils were still operating long after conventional coils had failed.

# NOW AVAILABLE IN MANY RATINGS OF THESE G-E INDUCTION MOTORS

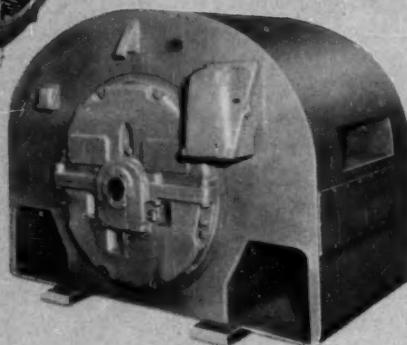
(Approximately 100 to 3000 hp)



Totally-enclosed  
fan-cooled



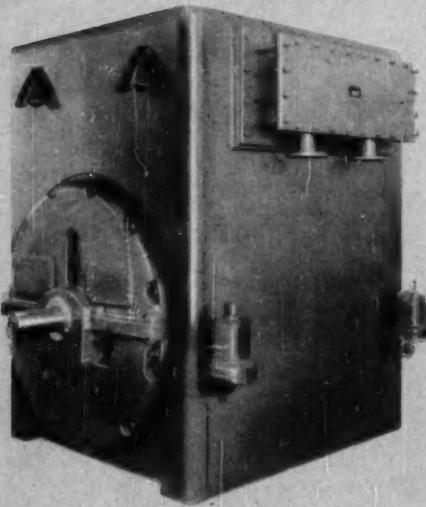
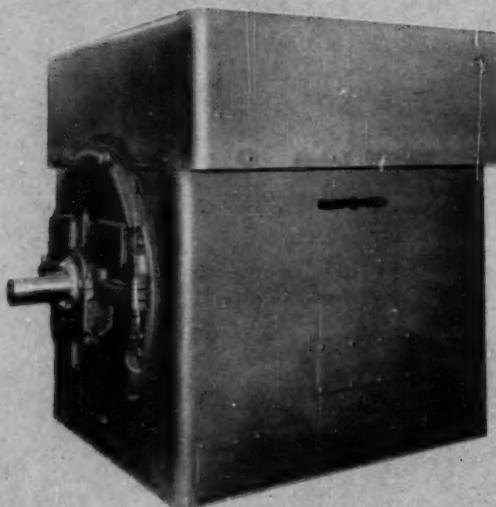
Open dripproof



Grade-mounted  
weather-protected

Base-ventilated  
weather-protected

Totally-enclosed  
air-water cooled



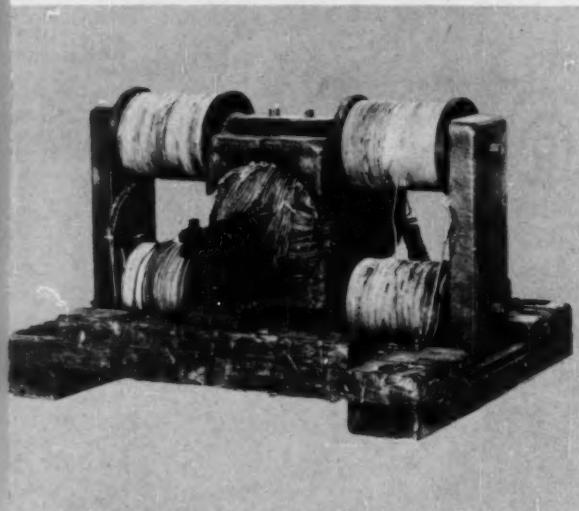
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**GENERAL ELECTRIC**



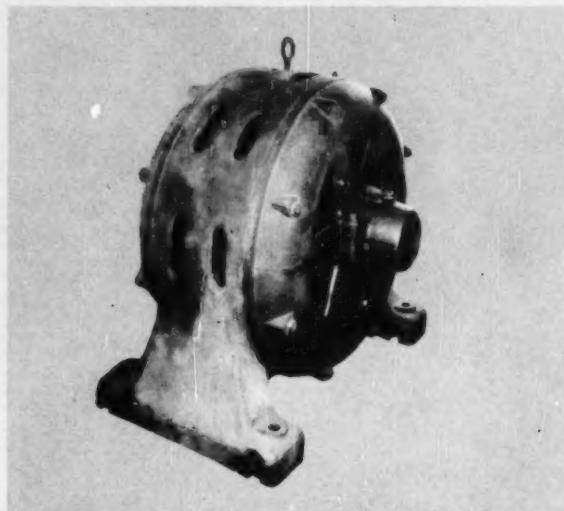


## THE THIRD MAJOR STEP IN THE EVOLUTION OF FORM-WOUND MOTOR INSULATION SYSTEMS



### 1878—FORM 1 INSULATION SYSTEM

Air was the insulator in early motor coils. Cotton was wrapped around the coils, but served only as a spacer to provide an air gap. The cotton wrapping itself was worthless as an insulator.

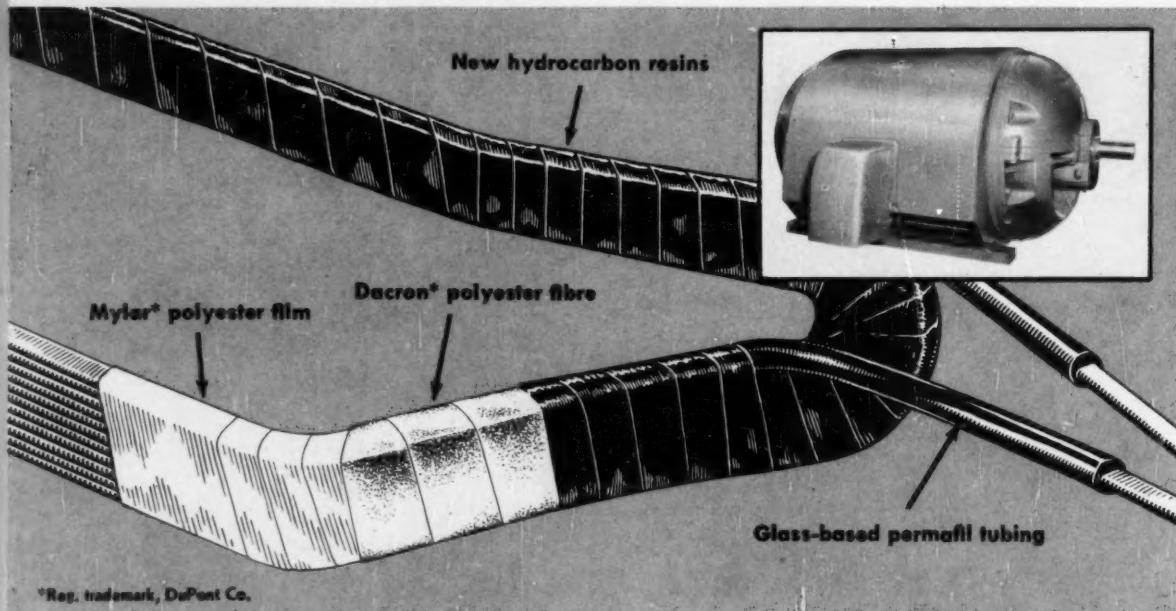


### 1910—FORM 2 INSULATION SYSTEMS ESTABLISHED

Linseed oil was added to cotton to provide insulating qualities. Since then, varnish and other insulating materials have replaced oil, but until now the basic concept has remained the same.

### 1954—G.E. INTRODUCES FIRST FORM 3 INSULATION SYSTEM

New G-E Polyex insulation becomes the first Form 3 insulation system. Made of polyester films and fibres, Polyex is the first insulation in which the materials have natural insulating qualities of their own.



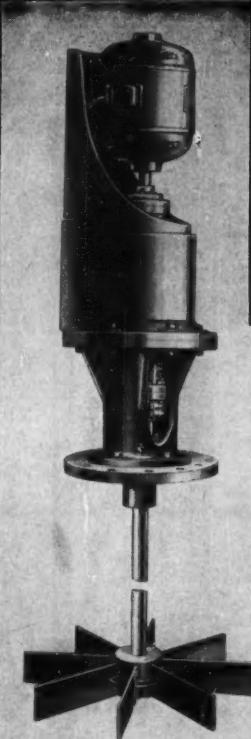
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**GENERAL ELECTRIC**

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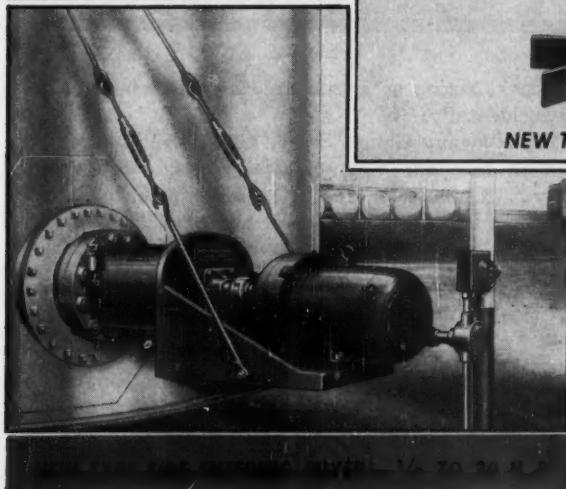
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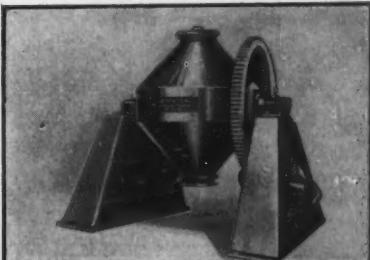


NEW TYPE 1 TO 100 H.P.

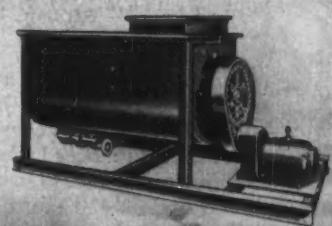


1 TO 200 H.P.

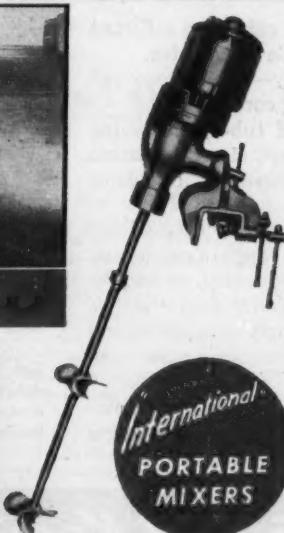
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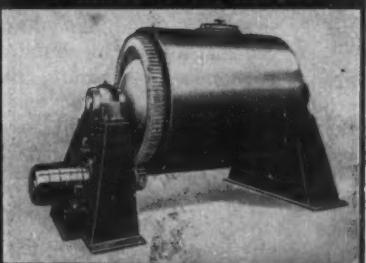


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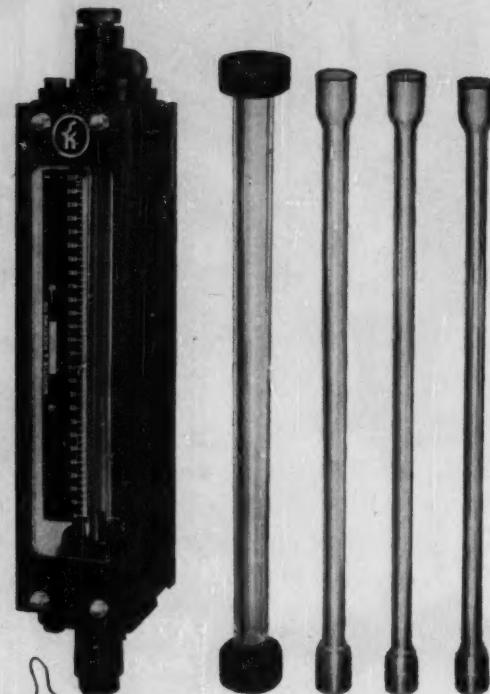
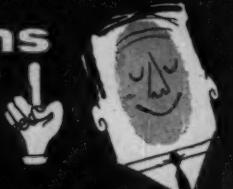
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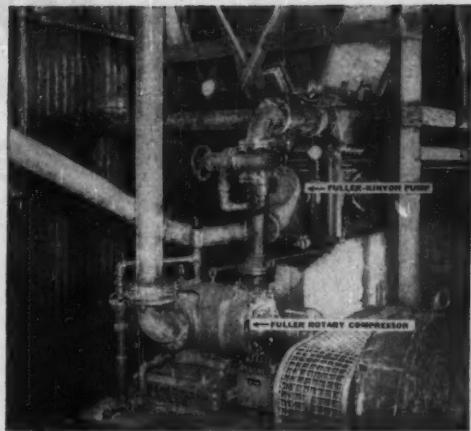
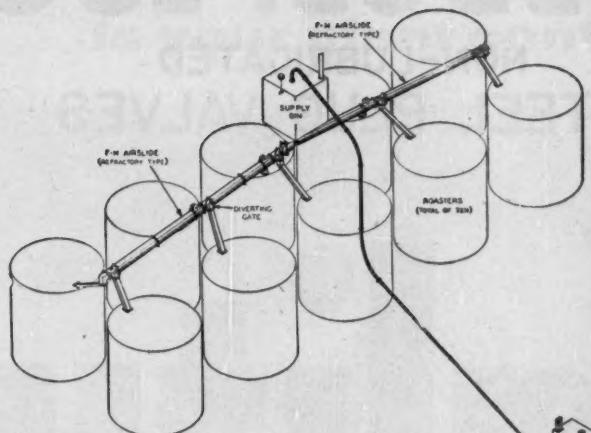
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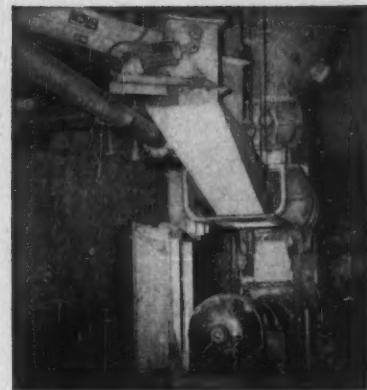
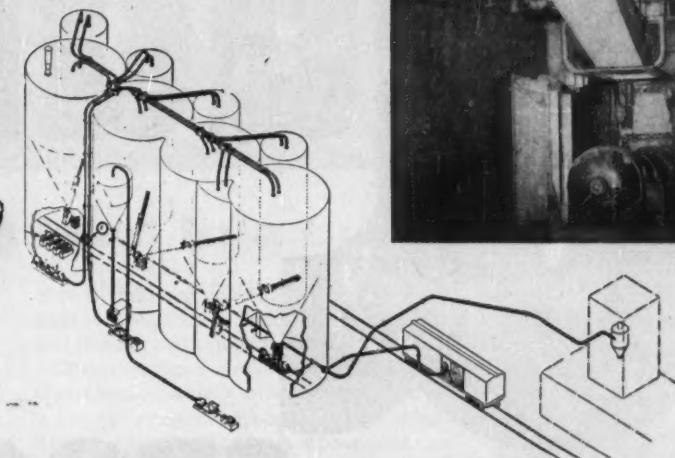
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Many conveying problems, heretofore considered impossible and impractical from an economic standpoint, are today being solved by the use of Fuller-Kinyon and F-H Airslide Conveyors, either individually or in combination.

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Installation, upper left, conveying hot flue dust. A Fuller-Kinyon Pump conveys from a precipitator to a supply bin. From the supply bin, F-H Airslides convey and control the distribution of the flue dust to roasters, with no dust or loss of material. Material handled has

a temperature up to 800 deg. fahr. The pump conveys at rate of 25 tons an hour over a distance of approximately 220 feet.

Drawing, lower right, talc conveying. Fuller-Kinyon Systems convey from pulverizers to storage silos and bins, and from storage to packer bin or bulk-car loading. F-H Airslides convey from flat-bottom storage bins to the Fuller-Kinyon Portable Pump illustrated above drawing.

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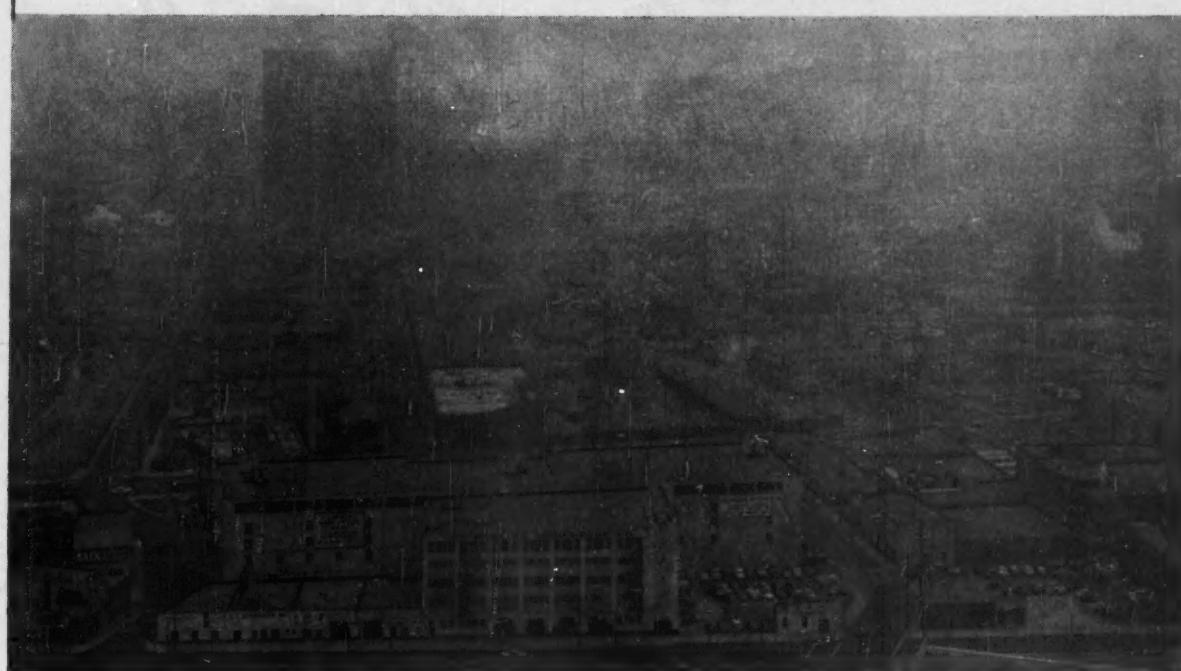
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The TITRILOG's continuous record of the concentration of SO<sub>2</sub>—one of the principal offending agents and a good index of pollution level—can serve two purposes. It can

warn of unsafe or undesirable levels of pollution; it provides the clue to the source—the first step toward curing the over-all condition.

If you are faced with the problem of keeping your community's atmosphere breathable . . . or the problem of controlling an industrial process where sulfur compounds are an important factor, contact Consolidated Engineering. One of our Field Engineers will be pleased to show what the Titrilog can do for you. Write for Bulletin CEC 1810C-X4.



### Consolidated Engineering CORPORATION

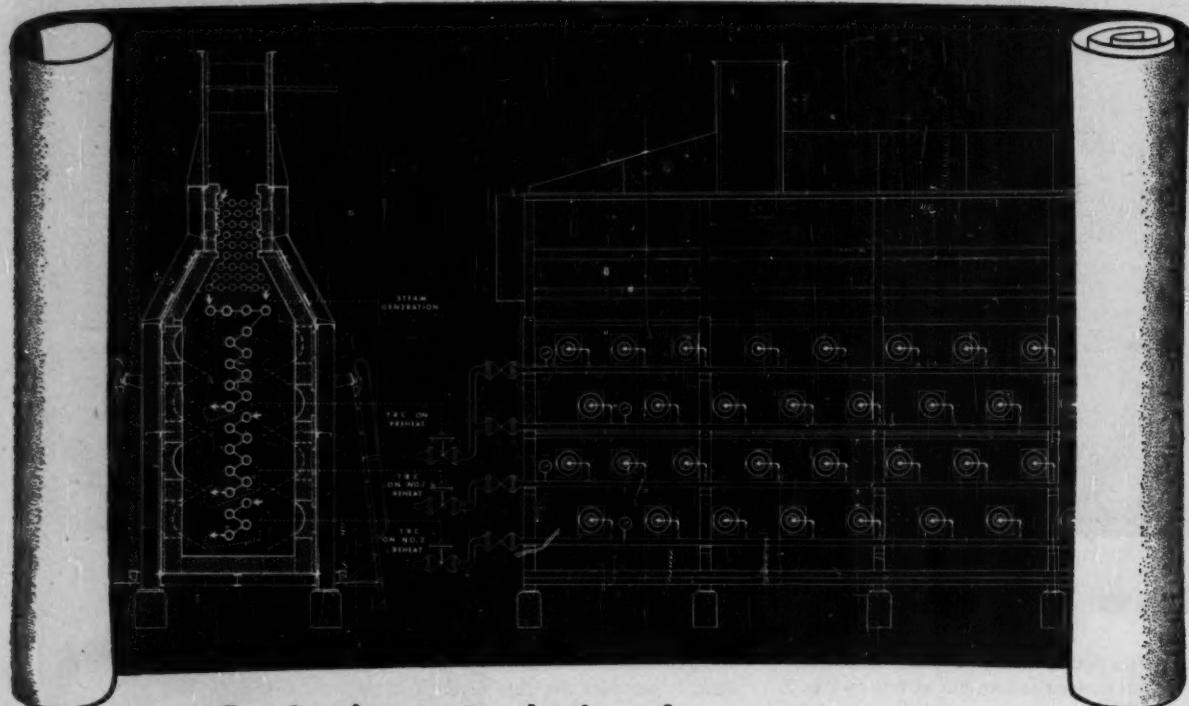
ANALYTICAL INSTRUMENTS FOR SCIENCE AND INDUSTRY

300 North Sierra Madre Villa  
Pasadena 15, California

Sales and Service through **CEC INSTRUMENTS, INC.**, a subsidiary with offices in: Albuquerque, Atlanta, Buffalo, Chicago, Dallas, Detroit, New York, Pasadena, Philadelphia, Seattle, Washington, D. C.

# ONE HEATER DOES JOB OF THREE

## with SELAS Zone Control



**For Continuous Production of  
Chemicals Requiring Multiple Reactor Processing**

● Selas Gradiation Heaters are proving their value for cutting costs . . . improving efficiency of operation . . . and saving ground space in the continuous production of carbon bisulfide and other chemicals requiring multiple reactor processing.

Where two or more process streams require separate heating, the precise Zone Control of Selas Heaters is achieved by manifolding fuel gas in such a manner that the flow to each horizontal row of burners can be controlled to the necessary level to maintain desired fluid outlet temperature. Where more than one control zone is provided for a single coil, tube wall or film temperature can be maintained constant over the entire radiant coil length.

### Results are:

- Multiple coils can be installed with absolute temperature control in a single radiant chamber.
- Flexibility in determining the meeting shape of heating curve.
- Prolonged tubelife . . . lower maximum tube wall temperature, through more uniform circumferential heat distribution, minimizes corrosion rate.

Selas Gradiation Zone Control offers new possibilities in every chemicals plant where heat processing is a precise operation. Let us send you more information in our bulletin on Gradiation Heating for the Chemical Industry.

# SELAS

## FLUID PROCESSING

CORPORATION OF AMERICA • PHILADELPHIA 34, PA.



# DAVISON BULLETIN

LIGHT AS A  
FEATHER

# SYLOID® 244

Syloid 244 is a highly porous pure silica gel of extremely low density. A free-flowing white powder, it appears as a fluffy snow weighing 4-4.5 pounds per cubic foot as shipped. Syloid 244 has an apparent particle size of 2-3 microns, yet individual particles are predominantly below one micron.

The chemical and physical characteristics of Syloid 244 makes it adaptable for many uses including the following:

- anti-blocking of clear plastic film
- an additive to inks for quick-drying
- a vinyl flattening agent
- anti-caking for powdered products
- thickening agent for salves, lubricants and plastigels

Progress Through Chemistry



## DAVISON CHEMICAL COMPANY

Division of W. R. Grace & Co.

Baltimore 3, Maryland

Producers of: Catalysts, Inorganic Acids, Superphosphates, Triple Superphosphates, Phosphate Rock, Silica Gels and Silico-fluorides. Sole Producers of DAVCO® Granulated Fertilizers.

### TYPICAL CHEMICAL AND PHYSICAL CHARACTERISTICS OF SYLOID 244

|  |  |
|--|--|
| Color . . . . .                                  | white, 94 Hunter reflectometer transparent in vehicles |
| Appearance . . . . .                             | uniform, free-flowing powder                           |
| Density . . . . .                                |  |
| as shipped . . . . .                             | 4-4.5 lbs./cu. ft.                                     |
| centrifuged in toluol . . . . .                  | 7.5 lbs./cu. ft.                                       |
| true (specific gravity) . . . . .                | 2.1-2.2  |
| pH . . . . .                                     | 7.2  |
| Silica as SiO <sub>2</sub> (dry basis) . . . . . | 99.5%  |
| Oil adsorption . . . . .                         | 240 lbs. oil/100 lbs. SiO <sub>2</sub>                 |
| Surface area (nitrogen) . . . . .                | 292 M <sub>2</sub> /gram                               |

### PARTICLE SIZE DISTRIBUTION BY WEIGHT

(water sedimentation)

|                          |     |
|--------------------------|-----|
| 5% less than 1.1 microns |     |
| 10                       | 1.4 |
| 20                       | 2.0 |
| 40                       | 3.0 |
| 50                       | 3.7 |
| 60                       | 4.5 |
| 80                       | 7.0 |

Low density  
Syloid 244  
shown balanced  
with feathers.

Write for complete  
information, suggested  
applications, etc., or  
contact your Davison  
Field Service Engineer.



# IF YOU HANDLE FUMES CONTAINING

Sulphuric Acid      Sulphurous Acid      Carbolic Acid  
Hydrobromic Acid      Hydrofluosilicic Acid      Hydrofluoric Acid  
Phosphoric Acid      Pyroligneous Acid      Acetic Acid      Citric Acid  
Chlorine      Oxalic Acid      Tartaric Acid      Formaldehyde  
Muriatic Acid      Zinc Sulphate      Ferrous Chloride      Caustic Potash  
Ferrous Sulphate      Sodium Acid Sulphate      Sodium Hypochlorite  
Copper Sulphate      Zinc Chloride      Bleach Liquor  
— And Other Corrosive Materials —

## "Buffalo" RUBBER-LINED EXHAUSTERS Can Save You Real Money

Cost records in hundreds of plants show that "Buffalo" Rubber-Lined Exhausters last from three to twelve times longer than ordinary metal fans, handling the above fumes! Savings far more than pay for the cost of rubber lining, to say nothing of reduction of down-time. Rotor, shaft and inside of housing have a protective coating of rubber vulcanized on, effectively sealing off fumes from the metal. It's just one more example of how the "Q" Factor\* saves you money when you specify Fans by "Buffalo". Write for Bulletin 2424-F for details.

\* The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.



**BUFFALO FORGE COMPANY**

501 BROADWAY

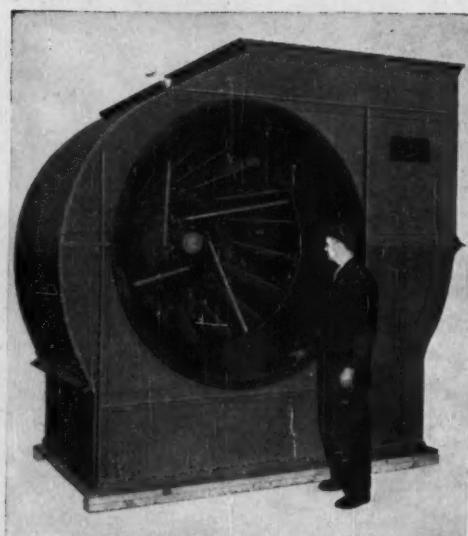
BUFFALO, N. Y.

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING



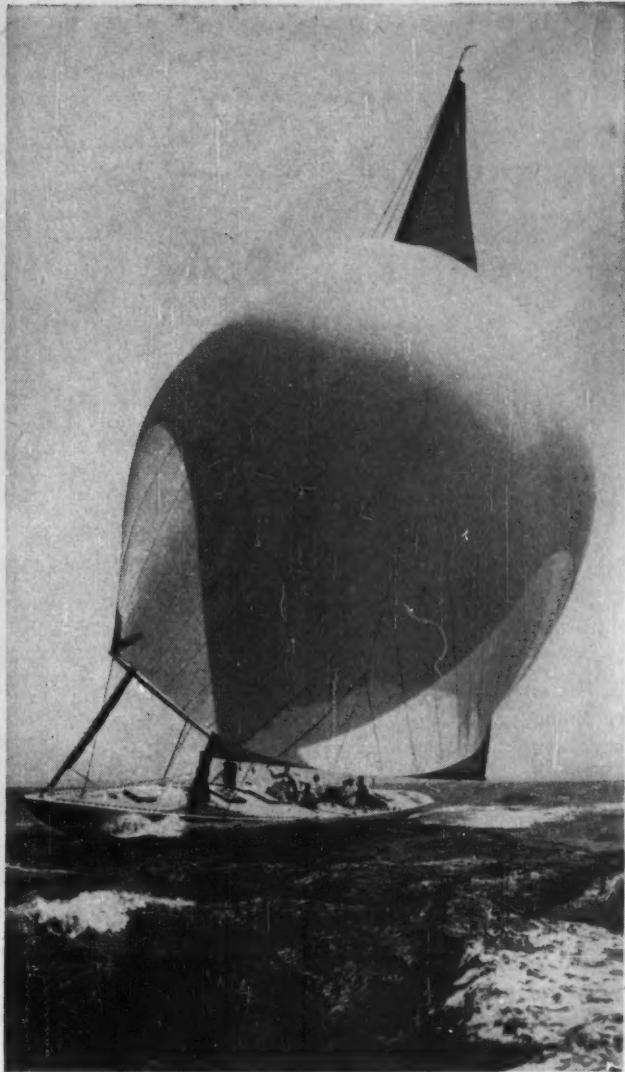
# Enjay helps keep your sales out front



**IN SURFACE COATINGS** (Paint and Varnish)



**IN PETROLEUM** (Lubricants and Gasoline Additives)



**IN CHEMICALS** (Synthetic Fibres)

Products that lead in sales are the products that deliver dependable quality and performance. And where quality and performance count, rely on Enjay. Enjay supplies the chemical, surface coating and petroleum industries with a complete line of uniform, high quality petroleum chemicals, backed by pioneering research, experience and proved results. Enjay is also ready to assist you in developing new or improved products through chemistry. Call Enjay next time for your chemical needs.

**Enjay Company, Inc. • 15 West 51st Street, New York 19, N. Y.**

#### PETROLEUM

PARANOX  
PARATONE  
PARAFLOW  
PARAPOID  
PARADYNE  
PARATAC  
PETROHOL  
Methyl Ethyl Ketone  
Dewaxing Aid  
Ethyl Ether  
Isopropyl Ether  
Reference Fuels

#### SURFACE COATING

PETROHOL 91  
PETROHOL 95  
PETROHOL 99  
JAYSOL  
Secondary Butyl Alcohol  
Secondary Butyl Acetate  
Isopropyl Acetate  
Acetone  
Methyl Ethyl Ketene  
Dicyclopentadiene  
Diethyl Ether  
Isopropyl Ether  
Naphthalic Acids  
Iso-Octyl Alcohol  
Decyl Alcohol  
Denatured Ethyl Alcohol

#### CHEMICAL

PETROHOL 91  
PETROHOL 95  
PETROHOL 99  
JAYSOL  
Iso-Octyl Alcohol  
Decyl Alcohol  
Denatured Ethyl Alcohol  
Tridecyl Alcohol  
Dicyclopentadiene  
Isopropyl Ether  
Bullockines  
Ethyl Ether  
Isopropyl Ether  
Tetrapropylene  
Tripropylene  
Aromatic Tars  
Benzene  
Acetone  
Methyl Ethyl Ketone



35 successful  
years of  
leadership in  
serving industry



for lower cost control  
of moderately Corrosive fluids

Fig. 2651-A Gate

JENKINS  
**NICKEL IRON**  
Valves with Type 316  
**STAINLESS STEEL**

Trim

Fig. 2624 Swing Check

This combination provides corrosion resistance well above the moderate need in many processing services with an investment well below that for all-stainless steel valves.

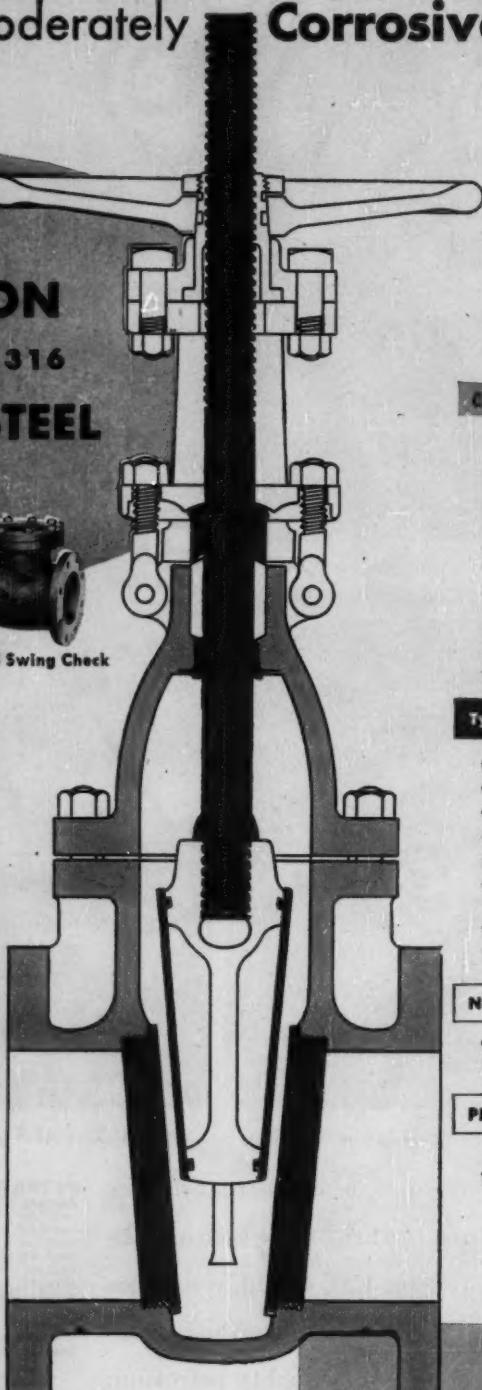
Designed primarily for the chemical process industries, they are recommended for control of mildly corrosive liquids with minimum quantities of mineral acids, such as creosote in wood treatment, and many liquids carried in petroleum processing.

A major use is in pulp and paper processing, particularly in lines serving the digester, and in the chemical recovery cycle. Service records in lines carrying the valve-punishing "black liquor" give Jenkins Nickel Iron Valves top performance rating.

Jenkins extra value construction throughout. Get details — compare. See why they stretch your valve investment dollar — with longer service life, lower maintenance cost.

ALSO RECOMMENDED for fluids used in electroplating, photograph finishing, textile bleaching, dyeing and finishing and heat treating of metals.

**GET COMPLETE SPECIFICATIONS** from your Jenkins Valve Distributor, or write: Jenkins Bros., 100 Park Ave., New York 17. Ask for Bulletin 118.



Every part in contact with fluid is the right metal to block corrosion and beat wear.

**CASE NICKEL IRON**

- **BODIES** Heavy duty, dimensioned for greater resistance to wear and abuse. Through port design in Gate Valves.
- **BONNET** Rugged construction, like body. Swing-type gland bolts. Screwed-in back-seating bushing. Deep stuffing box.
- **YODE** Integral with bonnet in 2" to 4" sizes.
- **WEDGE** In 10" to 24" sizes, with Stainless Steel Wedge Rings.
- **COVER** In Check Valve.

**Type 316 STAINLESS STEEL**

- SPINDLE
- GLAND
- BONNET BUSHING
- SPINDLE RING
- WEDGE PIN
- WEDGE RINGS Rolled into Nickel Iron Wedge in 10" to 24" sizes.
- SEAT RINGS
- DISC and HANGER in Check Valve

**NI-RESIST Type No. 2**

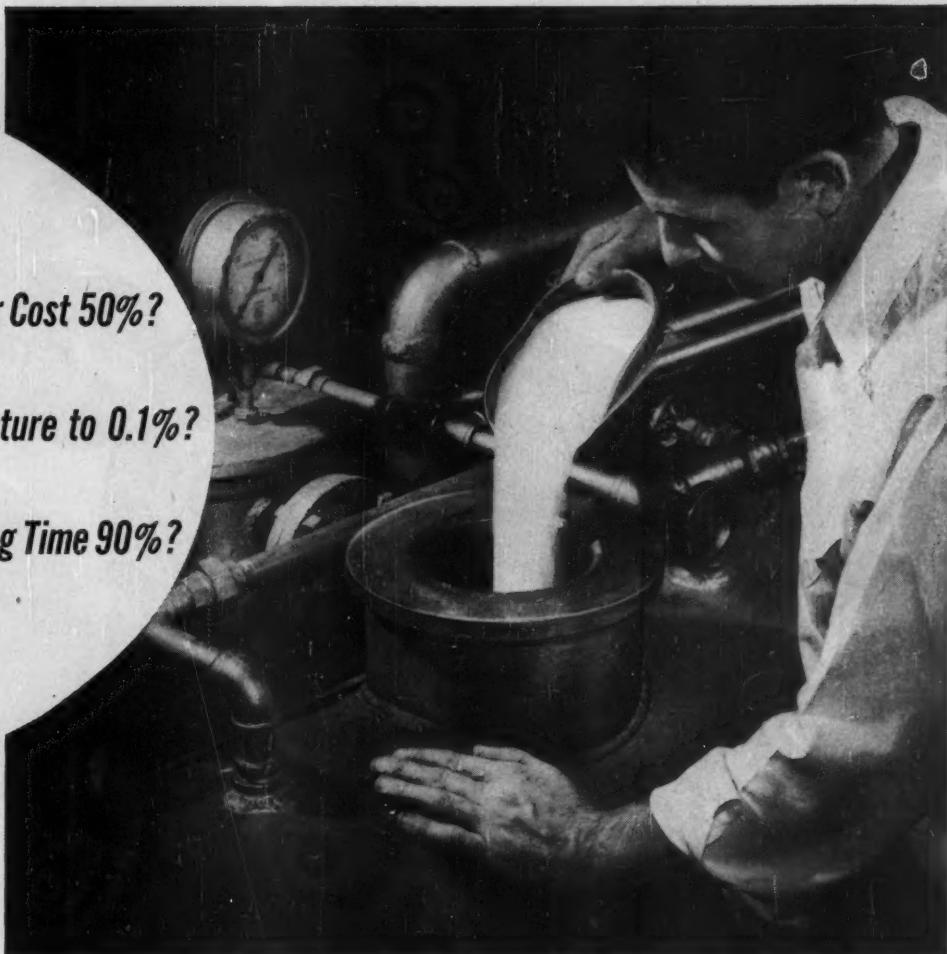
- WEDGE of I-beam structure is solid NI-RESIST in 2" to 8" sizes.

**PRESSURE RATINGS**

- 2" to 12"—200 lbs. O.W.G.
- 14" to 24"—150 lbs. O.W.G.

**JENKINS**  
LOOK FOR THE DIAMOND MARK  
**VALVES**





**What Cuts Labor Cost 50%?**

**What Cuts Moisture to 0.1%?**

**What Cuts Drying Time 90%?**

Labor and time are reduced 50% by vacuum drying of a mixture of acetyl salicylic acid and other chemicals.

Sodium trichloracetate is reduced from 35% to 0.1% moisture content in 8 to 12 hours by vacuum drying.

Several makers of powdered aluminum and brass avert fire and explosion hazards by drying powders and solvents in vacuum . . . then recover 99% or more of the solvent in the same process.

Shellac is dried in vacuum in 6 to 8 hours per batch, a job that formerly took 72 hours!

Stokes has the laboratory and pilot plant facilities to test vacuum drying of any product which offers drying difficulties. Methods, cycles, equipment, costs will be accurately determined. Stokes has 40 years' experience in vacuum technology to share with you on drying problems.

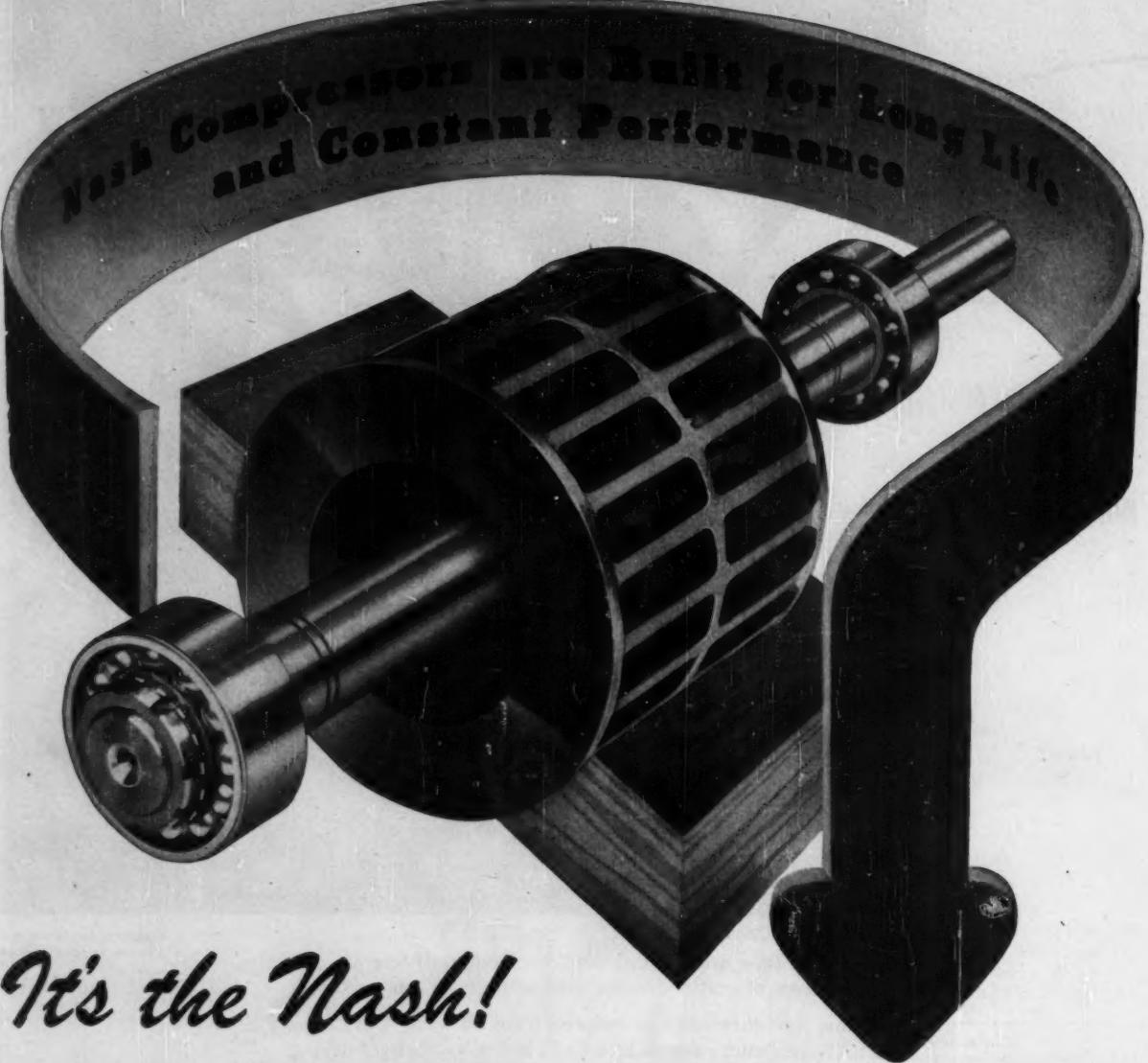
Send for an informative brochure, "Vacuum Drying," on the techniques of moisture removal from chemicals, pharmaceuticals and other industrial products.

**F. J. STOKES MACHINE COMPANY  
PHILADELPHIA 20, PA.**

Operator loads Rotary Vacuum Dryer in Stokes pilot plant.

**STOKES**

**STOKES MAKES:** High Vacuum Equipment, Vacuum Pumps and Gages / Industrial Tabletting, Powder Metal and Plastics Molding Presses / Pharmaceutical Equipment



## *It's the Nash!*

The ability of Nash Compressors to maintain original performance over long periods is no accident. Nash Compressors have but a single moving element, the Nash Rotor. This rotor is precision balanced for long bearing life, and it revolves in the pump casing without metallic contact. Internal lubrication, frequent cause of gas contamination, is not employed in a Nash. Yet, these simple pumps maintain 75 lbs. pressure in a single stage, and afford capacities to 6 million cu. ft. per day in a single compact structure.

Nash Compressors have no valves, gears, pistons, sliding vanes or other enemies of long life. Compression is secured by an entirely different principle of operation, which offers important advantages often the answer to gas handling problems difficult with ordinary equipment.

Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. Because there are no internal wearing parts, maintenance is low. Service is assured by a nation-wide network of Engineering Service offices. Write for bulletins now.

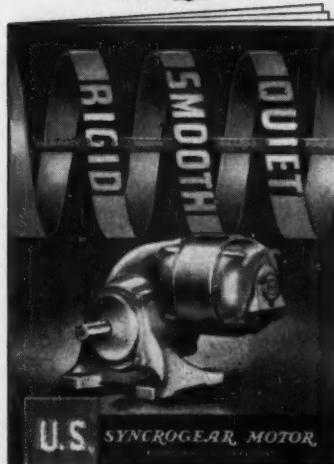
- No internal wearing parts.
- No valves, pistons, or vanes.
- No internal lubrication.
- Low maintenance cost.
- Saves floor space.
- Desired delivery temperature automatically maintained.
- Slugs of liquid entering pump will do no harm.
- 75 pounds in a single stage.

**NASH** ENGINEERING COMPANY  
312 WILSON, SO. NORWALK, CONN.



# U.S. NEW TYPE GW SYNCROGEAR MOTOR

Mounting stresses absorbed.  
Gear and motor distortion-free.



Permanently accurate gear and bearing alignment are vital in any right-angle, worm-gear motor. In the amazing new Type GW Syncogear motor the *cantilever* principle is employed. Why? —To prevent stress of motor and gear mounting. A solid-cast Unibase pyramidal supports the entire load. Type GW is extremely compact. Gear is sealed in dustproof case. Speeds, 20 to 155 r.p.m. Gear ratios up to 87:1. Horsepower,  $\frac{1}{4}$  to 2.

MAIL COUPON  
for this new free  
**SYNCROGEAR**  
BOOKLET

**RIGHT-ANGLE**

**WORM-GEAR**

**SOLID CAST UNIBASE**

**PYRAMIDAL SUPPORT**

**CLOSE-HITCH**

**SEALED PROTECTION**

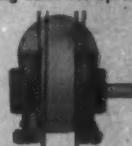
## HOW U. S. CANTILEVER DESIGN INSURES ALIGNMENT

U. S. MOTOR  
DESIGN



Motor and gearing mounted on single base. Cantilever position of motor is independent of external mounting stresses. Uneven floor mounting can't set up stress.

ORDINARY  
DESIGN



Gear and motor units mounted between two separate brackets permit distortion by bolting to irregular mounting surfaces.

New multi-colored descriptive booklet gives full engineering details.

**U. S. ELECTRICAL MOTORS Inc.**  
Los Angeles 54, Calif. • Milford, Conn.

## REQUEST FOR TYPE GW SYNCROGEAR BOOKLET

U. S. Electrical Motors Inc.  
P. O. Box 2058, Los Angeles 54, Calif. or Milford, Conn.

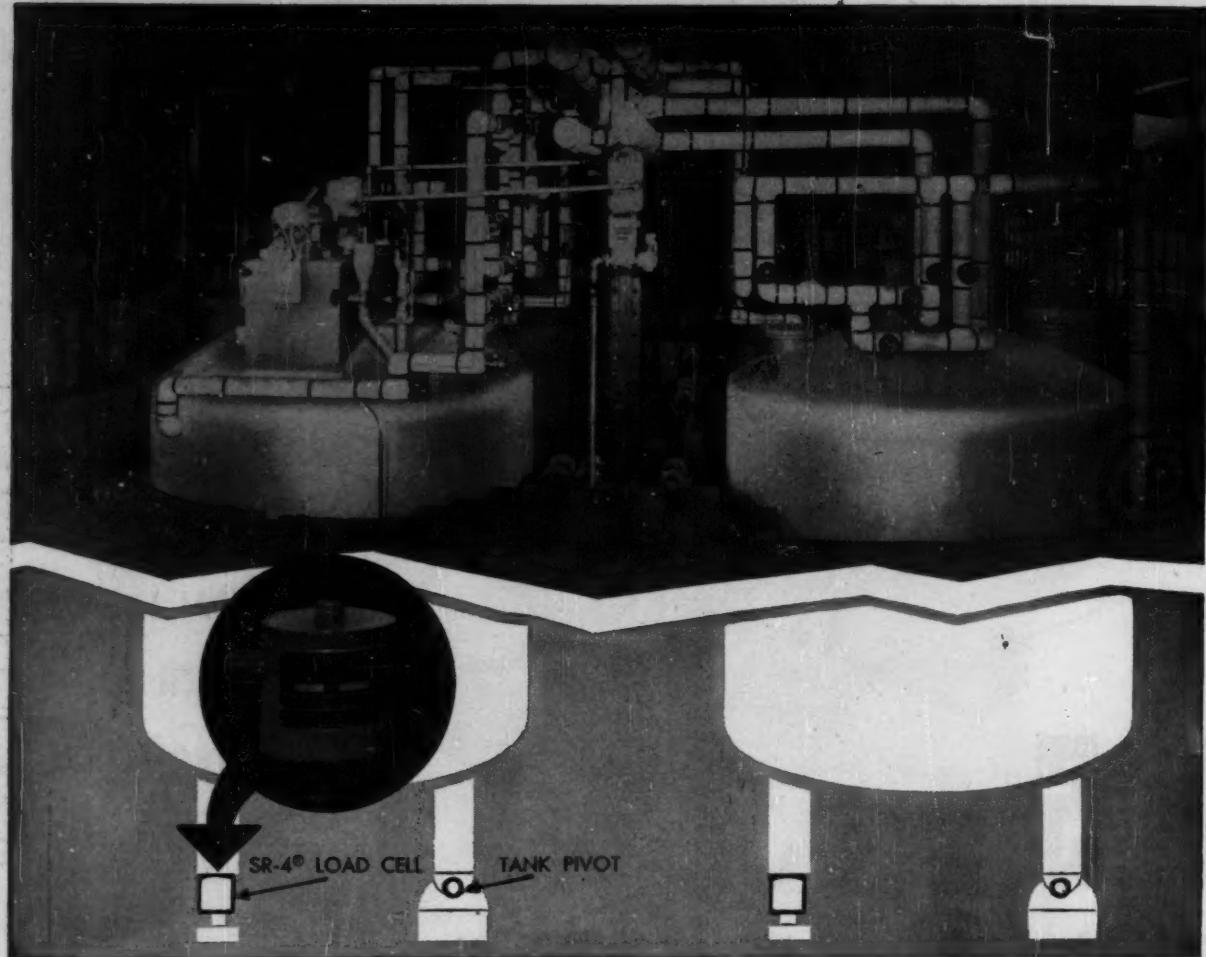
NAME \_\_\_\_\_

COMPANY \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_

ZONE STATE \_\_\_\_\_



## Baldwin SR-4® Load Cells Permit Remote and Automatic Control of Latex "Batching"

### THE PROBLEM:

In order to weigh liquid latex directly in the processing tanks, this leading rubber company sought a method which would require very little head room, use a minimum of steel and control various steps of each batch with  $\frac{1}{2}$  of 1% accuracy.

### THE BALDWIN SOLUTION:

Every requirement was met by the installation of a Baldwin SR-4 weighing system. Each 2,000 gal. tank, holding 16,000 pounds of latex, is supported by three legs. Two of the legs have rod-end bearings and the third rests on one 10,000 pound SR-4 Type C Load Cell. As the tank fills, changes in its weight are transmitted by electric cables from the cells to a switching unit and an indicator-controller on the upper floor.

### This system offers these benefits:

- It controls automatically the entire batching operation, providing lights and alarms for empty and full conditions of the tank. It also has adjustable controls

between empty and full for sizing each particular batch by controlling motorized valves.

- The SR-4 system made it unnecessary to use much steel during installation. The small size of the load cells meant that the available headroom (14 inches) was ample.
- The SR-4 Cells' rugged construction and absence of moving parts, combined with good instrumentation and proper engineering, have enabled this system to maintain constantly its inherent accuracy of  $\frac{1}{4}$  of 1% of capacity.
- Due to the electrical nature of SR-4 cells, they could be located on one floor and the indicating-controlling instrument on another.

### SR-4 Devices in Industry... Uses Unlimited

For measuring load, fluid pressure, or torque more accurately and economically Baldwin SR-4 devices have *unlimited uses* in industry. Write for our two new booklets on tank weighing (No. 4106) and crane scales (No. 4105). Address: Dept. 3104 Baldwin-Lima-Hamilton Corporation, Philadelphia 42, Penna.



# BALDWIN-LIMA-HAMILTON



HANDS TIED  
BY  
TRADITION?

## Make use of the Unique Advantages of TONNAGE OZONE in your Oxidations

You may have been limited in the past to traditional solutions of your oxidation problems . . . but now you are free to consider the value of this outstanding new approach—Welsbach Tonnage Ozone.

Ozone has always been regarded as a powerful oxidizing agent but there were problems—availability and dependability. Now those problems have been answered—with low-cost Tonnage Ozone, produced where it is used . . . by dependable Welsbach Ozonators.

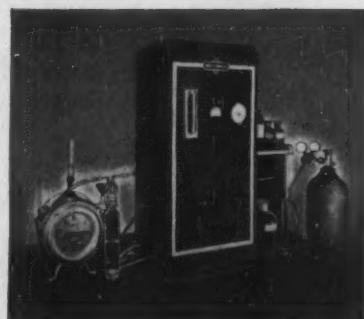
Just consider these unique advantages—advantages which only Welsbach Ozone can offer!

1. No procurement problems. No freight, storage or materials handling expense. Welsbach Ozone is generated where it is used.
2. Fully automatic for continuous processing—maintenance costs are negligible. And since the only raw materials needed are electricity and air or oxygen, operating costs are constant and predictable.
3. Inorganic reaction with ozone is quantitative and instantaneous. And, since only oxygen is added, no post-oxidative cleanup is needed.

4. Ozone cleavage of unsaturated organic compounds is very specific, resulting in higher yields of purer products at a lower cost.
5. Ozone can act as a catalyst in oxygen or air oxidations without requiring high temperatures and pressures.

### TRY OZONE IN YOUR LABORATORY

The Welsbach T-23 Laboratory Ozonator is designed specifically as a precision laboratory instrument capable of constant and reproducible operation, positively safe to use. It effects substantial savings in research time through earlier completion of research projects at a lower cost. Write today for descriptive folder on the Model T-23 and, if you wish, indicate the nature of your problem. The Welsbach Corporation, Ozone Processes Division, 1500 Walnut Street, Philadelphia 2, Pa.

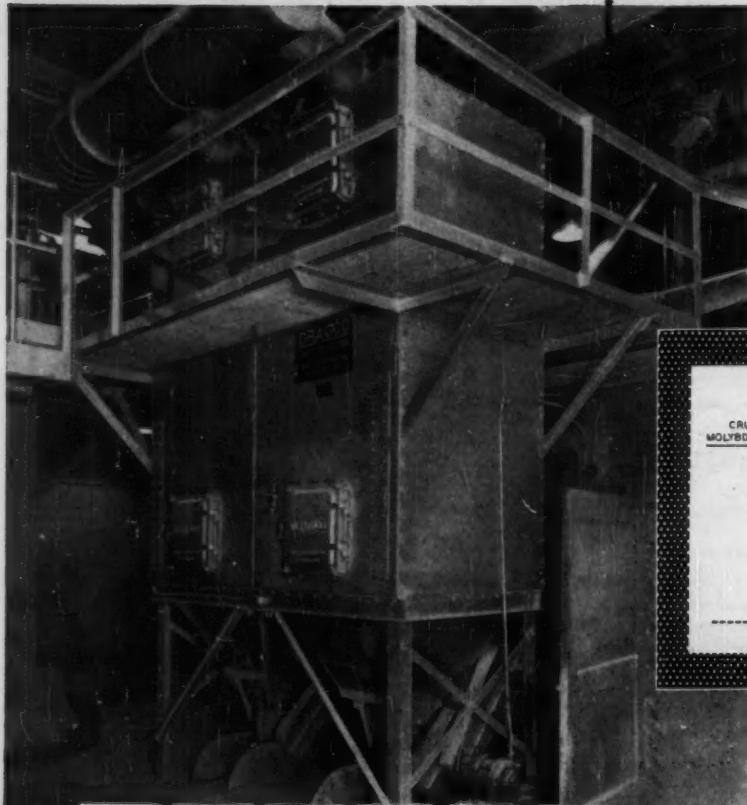


Welsbach Model T-23 Laboratory Ozonator—Gives constant, reproducible operation with no ozone leaks, no electrical hazards and substantial savings in research time and money. You'll appreciate its professional refinements.

**WELS BACH**  
ZONE IS TONNAGE OZONE  
LOW COST • DEPENDABLE



## CATCHING HOT FUMES FOR HIGH-PURITY METALS!



# DRACCO

*Airstream* CONVEYORS • DUST CONTROL EQUIPMENT

● Recovery of all pure molybdenum trioxide—that's the vital job done by Dracco Dust Control Equipment at the Climax Molybdenum Co., Langlooth, Pennsylvania.

This valuable compound is important in the technology of the new "pure" metals now being used for high temperature alloys and electronic components. It is sublimed by Climax from crude molybdenic oxide in a continuously operating electric furnace. Pure  $\text{MoO}_3$  fumes which are released in this sublimation process are carried to two Dracco Dustomatic Filters for collection.

Then, prior to packing for shipment, the collected product is agglomerated and dried. To eliminate loss of any  $\text{MoO}_3$  which may become air-entrained at this stage, two more Dracco Dustomatic Filters are integrated with processing and packaging equipment. All air-entrained particles are captured and re-introduced to process.

This Dracco Dust Control System—upon which pure  $\text{MoO}_3$  production at the Climax Langlooth plant is completely dependent—assures contaminant-free product recovery at maximum efficiency.

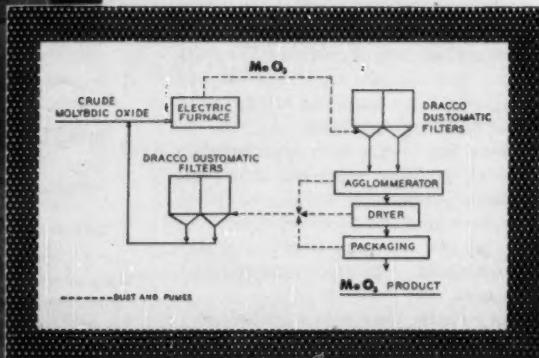
If your profits depend on catching *all* of your product, consult Dracco about a peak efficiency dust control system.

**DRACCO CORPORATION**

4040 EAST 116th STREET • CLEVELAND 5, OHIO

Two large Dracco Dustomatic Filters are integrated with an electric furnace to capture hot  $\text{MoO}_3$  fumes released in sublimation of crude molybdenic oxide. Dracco Filters (left) eliminate product loss during final processing operations.

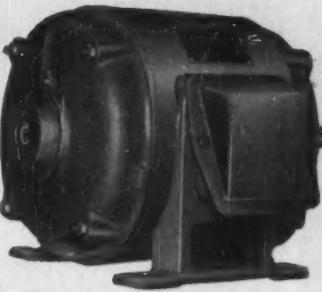
Diagram shows how Dracco Dust Control Equipment is integrated with other processing equipment used by Climax in the manufacture of pure molybdenum trioxide.



For complete technical information on "Industrial Dust Control and Recovery", write today for Dracco Bulletin 800.

*Performance Proved*

# NEW *Century* Performance-Rated<sup>®</sup> INTEGRAL H.P. MOTORS



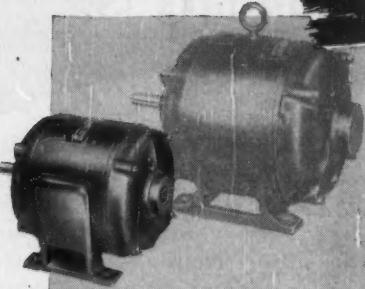
Now available in  
1...1½...2 H.P. sizes—  
NEMA frames 182 and 184.

## Improved Motors

to match your needs

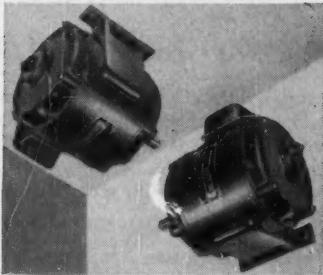
### SMALLER — LIGHTER

More uniform silicon-laminated steel; thinner, tougher "Mylar" slot insulation — just two of the many technical developments that help make these new Century Performance Rated Motors so much smaller and lighter.



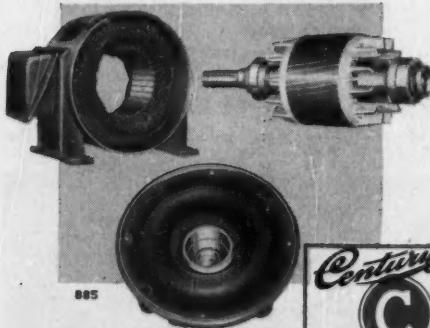
### BETTER PROTECTION

New concepts of internal motor ventilation permit end bracket and frame design that gives far better protection from falling liquids and solids... still maintain 40°C. temperature rise.



### MORE FLEXIBLE MOUNTING

You can even have cushion mounting with these new Century Integral H.P. Motors — your choice of sleeve or ball bearings. Ball bearing motors mount vertically, upside down, in any position. End brackets can be rotated for floor, ceiling or side wall mounting.

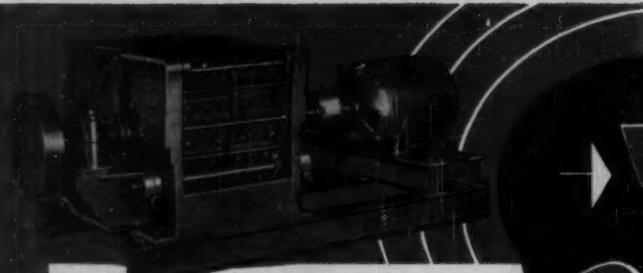


Offices and Stock Points  
in Principal Cities



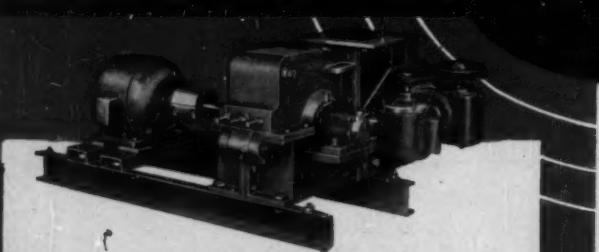
Specify CENTURY Performance Rated motors for your equipment. Call a Century District Sales Office or your nearest Century Authorized Distributor.

CENTURY ELECTRIC COMPANY • 1806 Pine Street • St. Louis 3, Missouri



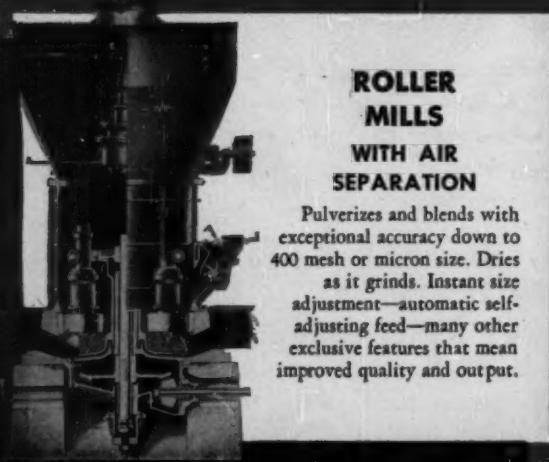
### HAMMER MILLS

A size for every purpose! Williams Hammer Mills are designed to do the complete job in a single operation. No primary or secondary crushers required—extra foundations, conveyors, other expensive equipment are eliminated—thus saving as much as 75% on initial investment and up to 50% on grinding costs!



### HELIX-SEAL HAMMER MILLS

Combines the advantages of a hammer mill with screw-type feed to obtain finenesses from 100 to 325 mesh. For dustless, cleaner, safer dry grinding—accurate, non-clogging reduction of sticky and wet materials. Eliminates separators, fans and cyclones. Furnished with water or steam jackets.



### ROLLER MILLS WITH AIR SEPARATION

Pulverizes and blends with exceptional accuracy down to 400 mesh or micron size. Dries as it grinds. Instant size adjustment—automatic self-adjusting feed—many other exclusive features that mean improved quality and output.

→ **WILLIAMS**  
has the  
*Right Answers*  
to all your  
**GRINDING, CRUSHING,  
SEPARATING PROBLEMS**

Whether your job demands crushing power shovel-loaded stone to 8 mesh or smaller in a single operation—whether it is pulverizing or blending, with or without air separation, of limestone or insecticides to finenesses down to 400 mesh, or even micron sizes—whether it is closed-circuit dustless dry grinding, or the grinding of wet and sticky materials to 325 mesh—there is a Williams "proved-in service" machine that can give you **A BETTER PRODUCT—FASTER PRODUCTION—and LOWER COSTS.**

It will pay you to get the facts about Williams equipment, and learn what it can do for your specific operation. Write Today For Literature.

### *Send Us Your Questions*

Complete testing and research facilities are maintained by Williams to develop the right answers, especially for your operation, on every size reduction problem. Write for information and the help of an experienced Williams technician.

### OTHER WILLIAMS EQUIPMENT

- Drier and Impact Mills
- Air Separators
- Vibrating Screens
- Complete "Packaged" Plants

### WILLIAMS PATENT CRUSHER & PULVERIZER CO.

2706 NORTH NINTH

★ ★ ★

St. Louis 6, Mo.



# WILLIAMS

CRUSHERS

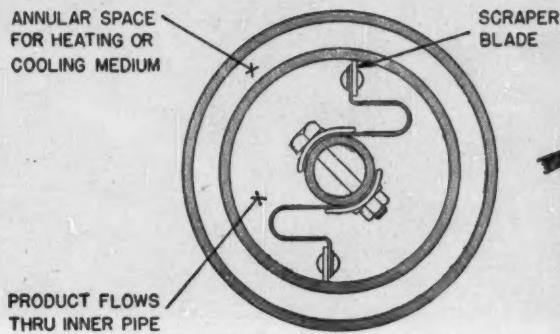
GRINDERS

SHREDDERS

OLDEST AND LARGEST BUILDER OF HAMMER MILLS IN THE WORLD

# Time to Change . . .

... FROM BATCH  
TO CONTINUOUS PROCESS



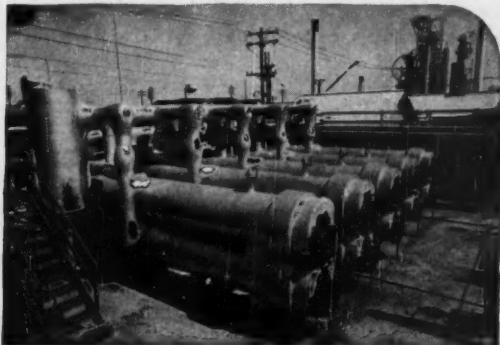
*Section thru Double Pipe Exchanger*



## Unsurpassed for Top Performance in Processing characterized by:

- 1 Heat transfer with crystallization
- 2 Heat transfer with severe fouling of surfaces
- 3 Heat transfer with solvent extraction
- 4 Heat transfer with continuous mixing and conveying
- 5 Heat transfer with high viscosity

*An outdoor installation of Scraped Surface Exchangers*



*Scraped Surface Exchanger Unit under test in our shop*

Chemical processors in search of equipment with which to modernize operations are invited to consider the possibilities of Vogt *flow-thru* Scraped Surface Exchangers in such service. The wide range of uses to which they have been adapted indicates their definite value in the chemical processing fields.

Vogt Scraped Surface Exchangers are closed, *flow-thru*, pressure type systems which permit the use of flammable, volatile and expensive solvents with greatest safety and no danger of solvent loss. Usually fabricated from ferrous material, their simple construction permits the ready use of special materials such as pure nickel or stainless steel to meet special requirements.

General information is in Bulletin PE-1, write for it.

# Vogt *flow-thru*

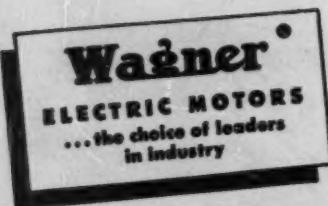
## Scraped Surface EXCHANGERS

HENRY VOGT MACHINE CO.

LOUISVILLE, KY.

BRANCH OFFICES:

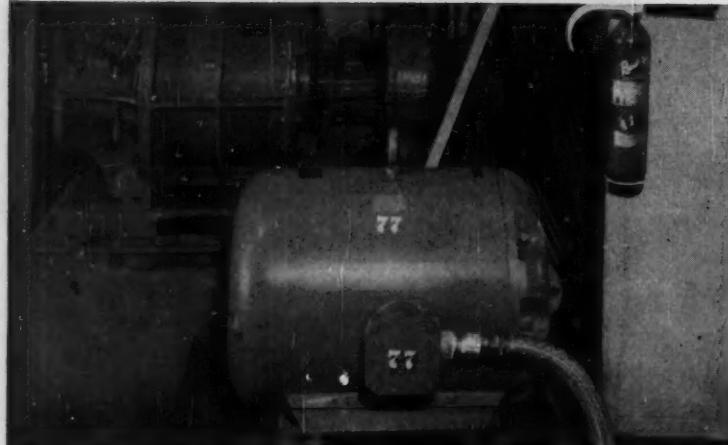
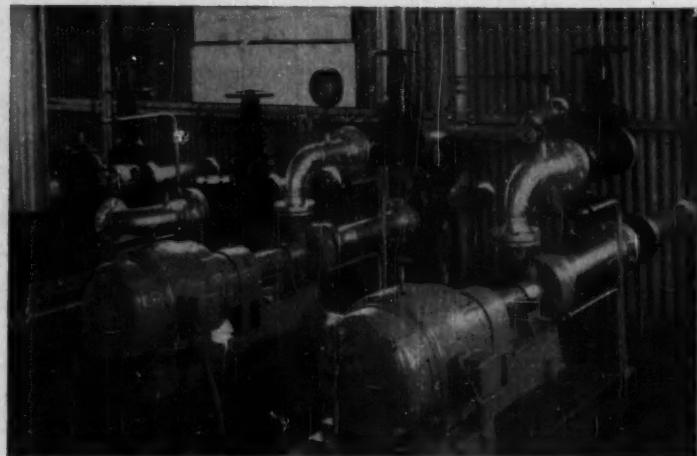
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St. Louis, Dallas, Charleston, W. Va.



**You can depend on Wagner Motors  
to furnish PLENTY OF POWER  
for compressors, pumps or blowers**



Wagner 15 hp  
Splash-proof  
polyphase motors  
driving water  
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at a large oil  
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Wagner 40 hp Explosion-proof  
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to draw grain into a hopper  
at a Southern brewery.

Motors that drive compressors, pumps and blowers need plenty of electrical and mechanical stamina to hold up under the hard, steady grind demanded by these applications.

Selecting the right motor for such equipment is not a problem of procuring specially built motors, but of choosing a standard Wagner Motor suited to the job. Wagner Motors are diversified in design and can be readily adapted to a wide range

of compressor, pump and blower applications. Improve the performance of your equipment by choosing Wagner Motors to power your compressors, pumps and blowers.

Bulletin MU-185 gives information on the complete line. Let a skilled Wagner engineer discuss your motor needs with you. Just call the nearest of our 32 branch offices, or write us.



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H54-6A

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ELECTRIC MOTORS  
TRANSFORMERS  
INDUSTRIAL BRAKES  
AUTOMOTIVE  
BRAKE SYSTEMS—  
AIR AND HYDRAULIC

## HERE'S HOW ONE REFINER SAVED WITH A LJUNGSTROM

### COMPARATIVE FUEL AND POWER COSTS

|  | WITH AIR HEATER | WITHOUT AIR HEATER |
|--|-----------------|--------------------|
| Heat absorption /hr millions of BTU                                      | 100             | 100                |
| Oil—inlet temp.—°F   | 700             | 700                |
| Flue gas temp. to stack—°F   | 400             | 950                |
| CO <sub>2</sub> to stack—%   | 10.0            | 11.0               |
| O <sub>2</sub> to stack—%  | 5.2             | 3.7                |
| EFF (assuming 5% radiation loss)—%                                       | 78.5            | 66.0               |
| Millions of BTU required/hr  | 127.39          | 151.52             |
| Annual cost of fuel (\$2.50/Bbl—8000 hrs)                                | \$392,000       | \$466,200          |
| Kilowatt-hours   | 80              |                    |
| Annual cost of energy @ 1¢/kwh—8000 hrs                                  | \$6,400         |                    |
| Annual operating cost—fuel and energy—8000 hrs                           | \$398,400       | \$466,200          |
| Annual fuel savings  | \$74,200        |                    |
| Annual net savings in operating costs<br>(fuel savings less energy cost) | \$67,800        |                    |

Wherever you burn fuel, you need LJUNGSTROM

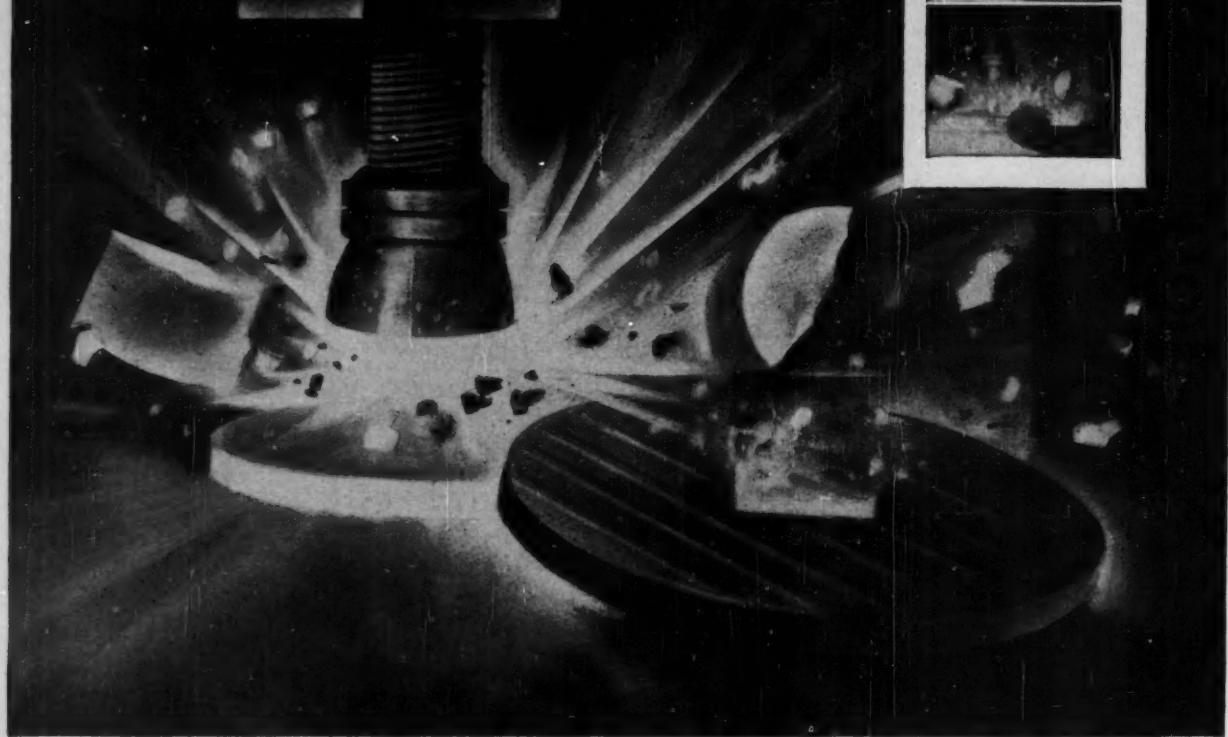
Listed in this table are comparative fuel and power costs for operating two identical deFlorez stills, one with and one without a Ljungstrom® Air Preheater. Operating costs *without* the Ljungstrom reflect performance with a convection bank of tubes.

*Remember: the initial cost of a Ljungstrom installation often is more than offset by the savings reflected in eliminating the convection bank.*

Remember, too — operating savings are only part of the story. Higher flame temperatures developed through the use of preheat increases heat transfer to oil tubes — thereby increasing throughput.

**The Air Preheater Corporation** 60 East 42nd St., New York 17, N. Y.

# HARSHAW TABLETED CATALYSTS made stronger through RESEARCH



## Rugged Tablets Reduce Reactor Shutdowns

Taken at 1/20,000th of a second, the pictures show a Harshaw catalyst tablet being tested for strength—one step in our research program designed to produce more efficient tableted catalysts having the highest useful strength. Our goal, of course, is to make the catalyst you want and need. First you specify, and then we produce.

Tougher, more efficient catalysts mean fewer

reactor shutdowns, and, naturally, more economic operation for you. Harshaw Catalysts mean fewer reactor shutdowns.

If your mind's on catalysts please contact us today by phone or letter.

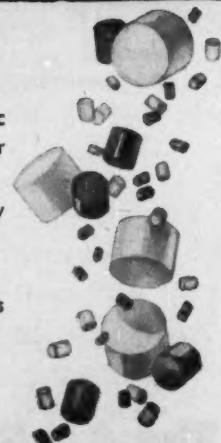
### *Harshaw catalysts available in these forms:*

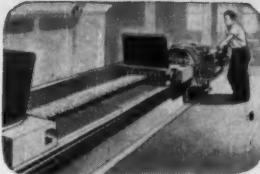
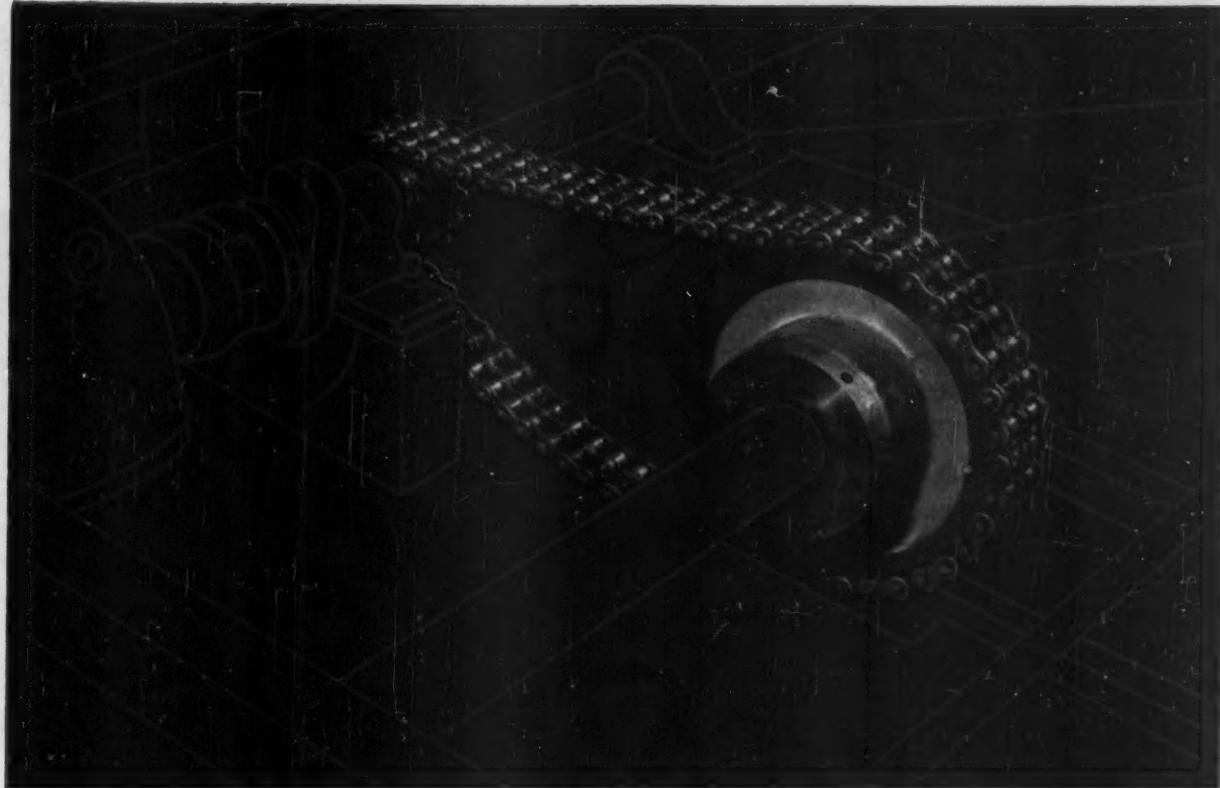
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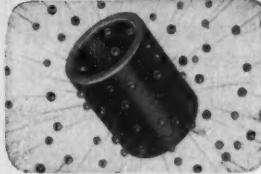
Cleveland 6, Ohio

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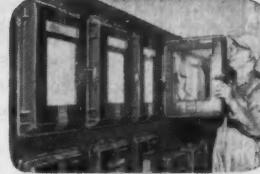




PRE-STRESSING of multiple width chain provides uniform load distribution.



SHOT-PEELED ROLLERS have greater fatigue life, added ability to withstand impact.



CLOSER HEAT-TREAT CONTROL — coupled with rigid testing insures uniformity.



LOCK-TYPE BUSHINGS (applied on a range of sizes) end a cause of stiff chain.

## How EXTRAS\* like these cut your roller chain costs

\*And you pay no premium for these LINK-BELT extras

LINK-BELT Precision Steel Roller Chain meets the three big requirements for lower drive and conveyor costs.

(1) **Long life**—Added manufacturing refinements like the four shown above are your assurance that Link-Belt roller chain lasts longer.

(2) **Low maintenance costs**—High resistance to wear eliminates frequent adjustments.

(3) **High efficiency**—Positive action, independ-

ent of atmospheric conditions. No power loss through slippage or excessive bearing friction.

You can get complete information from 148-page Data Book 2457. It covers single and multiple width roller chain and sprockets in  $\frac{1}{4}$ " through 3" pitch, 1" through 3" double pitch. Ask your nearest Link-Belt office or authorized stock carrying distributor for a copy today.

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LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office, New York 7; Canada, Scarborough (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

# With PELLETING

improve your product or process!

*Check the following pelleting advantages. Relate them to your materials and processes. You may discover new ways to cut your costs and improve your products and your process.*

1. Pelleting reduces or eliminates the dusting characteristics of materials.
2. Pelleting helps preserve original moisture content, chemical analysis and other properties.
3. Pelleted materials flow freely, can be binned, sacked, and packaged easily.
4. Hard, shiny pellets have greater sales appeal than loose material.
5. Densifying materials-in-process through pelleting improves their filtering qualities, permits granulating, and decreases dispersion rate. It also greatly increases density, facilitating storage and shipment.

Such materials as ammonium chloride, insecticide dusts, clay, citrus meal for use as an antibiotic carrying agent, fertilizer, granular hygroscopic products, and many others are often pelleted to great advantage.

Let a Sprout-Waldron Man survey your products and processes—without cost or obligation—with an eye to increasing your profits. Sprout-Waldron's equipment and vast experience in adapting pelleting for use in many fields may be of value to you. Write for details!

## SPROUT-WALDRON CONTINUOUS PELLETER

This machine produces top-quality pellets in tremendous volumes at reasonable investment and low operating cost. Small and large pellets—even 1" cubes—can be produced in many shapes and sizes. Pellets  $3/16$ " in diameter and  $1/4$ " long can be produced from some materials at capacities of 10 tons or more per hour with only 75 h.p. The advanced features of this machine are unequalled in the industry.

**Quiet V-belt drive.**

**Exclusive hinged die casing for easy access.**

**Corrosion-proof, stainless steel construction of feeder-conditioner and spout.**

**Revolving die cover and material-lifting flights assure long roll life . . . greater capacity.**

**Entire mill uses only 4 standard main bearings. Overall height, only 5 ft.**

(A smaller sized model is also available.)

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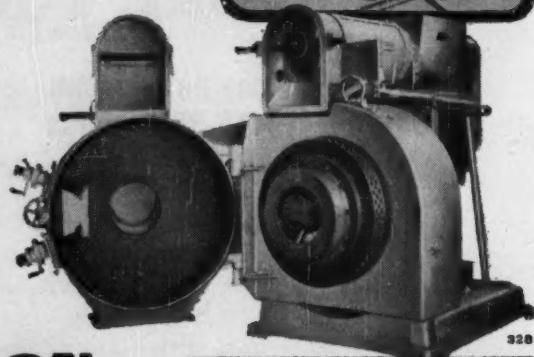


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*Manufacturing Engineers Since 1866*

Equipment for SIZE REDUCTION • MIXING & BLENDING • PELLETING & CUBING • BULK MATERIALS HANDLING • PRODUCT CLASSIFICATION

Facilities for fabricating, machining, custom founding, woodworking, laboratory testing  
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This odd-appearing structure, made of type 310 stainless steel, is now hard at work in a catalytic cracking plant for one of the nation's largest utility companies. It's one more example of the many unusual pressure vessels being fabricated by Acme for chemical processing installations everywhere. Whether the vessel or component you need is large or small, irregular in shape or unusual in design, Acme's complete facilities — including the latest mobile X-Ray equipment — guarantee you exact adherence to your specifications as well as to your delivery schedules. Find out now why so many important companies specify Acme weldments . . . call us today.

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A.S.M.E. U68-U69 Qualified Welders • A.P.I.-A.S.M.E. Approved  
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**Swenson Long-Tube Vertical Evaporators** Booklet on high-capacity, steam-saving evaporators for concentrating mobile and foamy liquids and heat-sensitive materials.

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**Swenson Spray Drying Equipment** 16 pages of facts, photographs, and diagrams explaining principles and advantages of spray drying and the Swenson plant-scale research laboratory.

Bulletin D-105



**Swenson Research Spray Dryer** A folder that describes and illustrates Swenson's completely packaged spray dryer for laboratory and pilot plant operations.

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**Swenson Rotary-Drum Vacuum Filters** Describing and illustrating Swenson job-engineered filter equipment for continuous low-cost, efficient filtration and washing.

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**Heat Transfer and Crystallization** A 52-page book giving practical presentation of the fundamentals of modern evaporation and crystallization methods and equipment.

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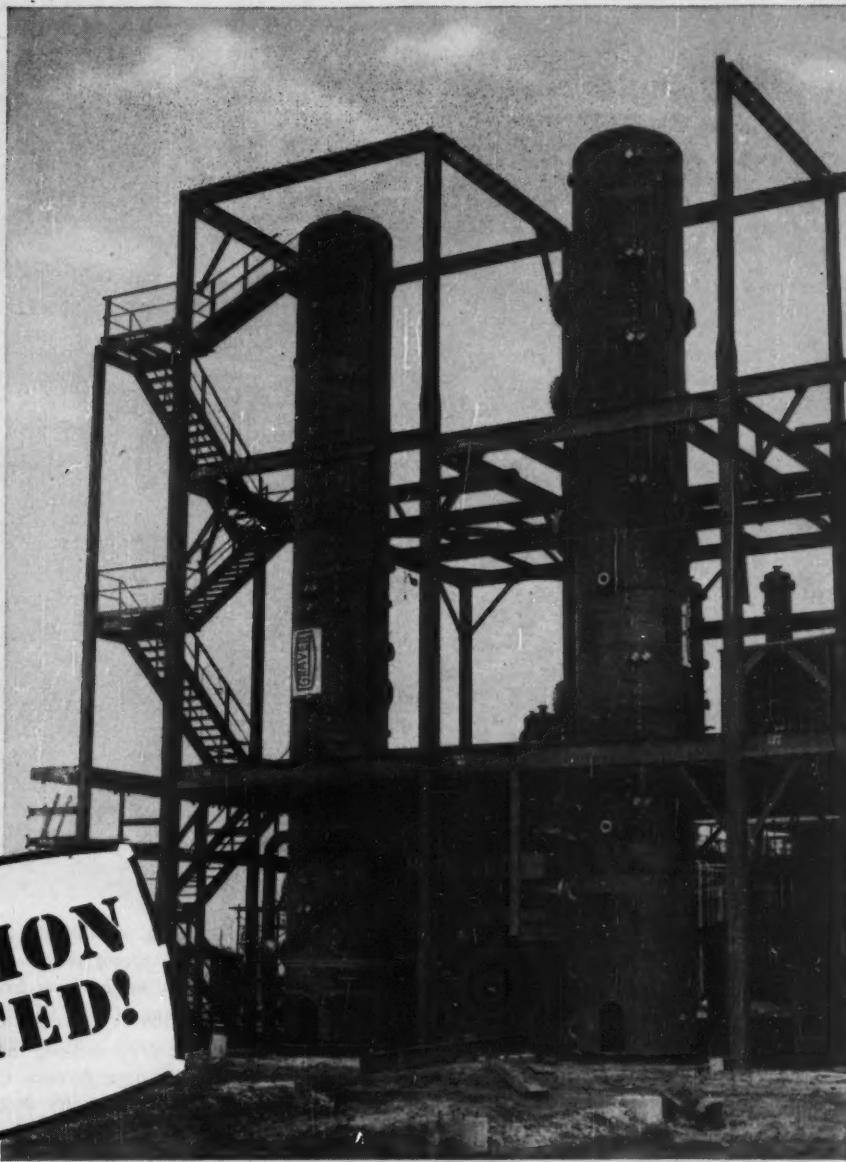
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**SWENSON**

Proven Engineering for the Process Industries

SINCE 1889





Here, at Tuscola, Illinois—site of the great National Petro-Chemicals Corporation installation—corrosion is a serious problem.

In the manufacture of ethyl alcohol from ethylene, sulfuric acid is used. To combat the corrosive action of acid in the two large towers shown above... one a saturation absorber, the other a cleanup absorber... Graver provided definite safeguards. For example, the

very "joints" of each of the towers were lined with special alloy strips. This is an exacting, difficult job, requiring unusual knowledge.

Graver's ability to fabricate alloy, stainless, clad, and other hard-to-work materials is exceptional, resulting from long experience and constant research. Where your problem is especially difficult and superior craftsmanship is a must...call on Graver!

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...specialists in the fabrication of towers,  
tanks, pressure vessels

**GRAVER TANK & MFG. CO., INC.**

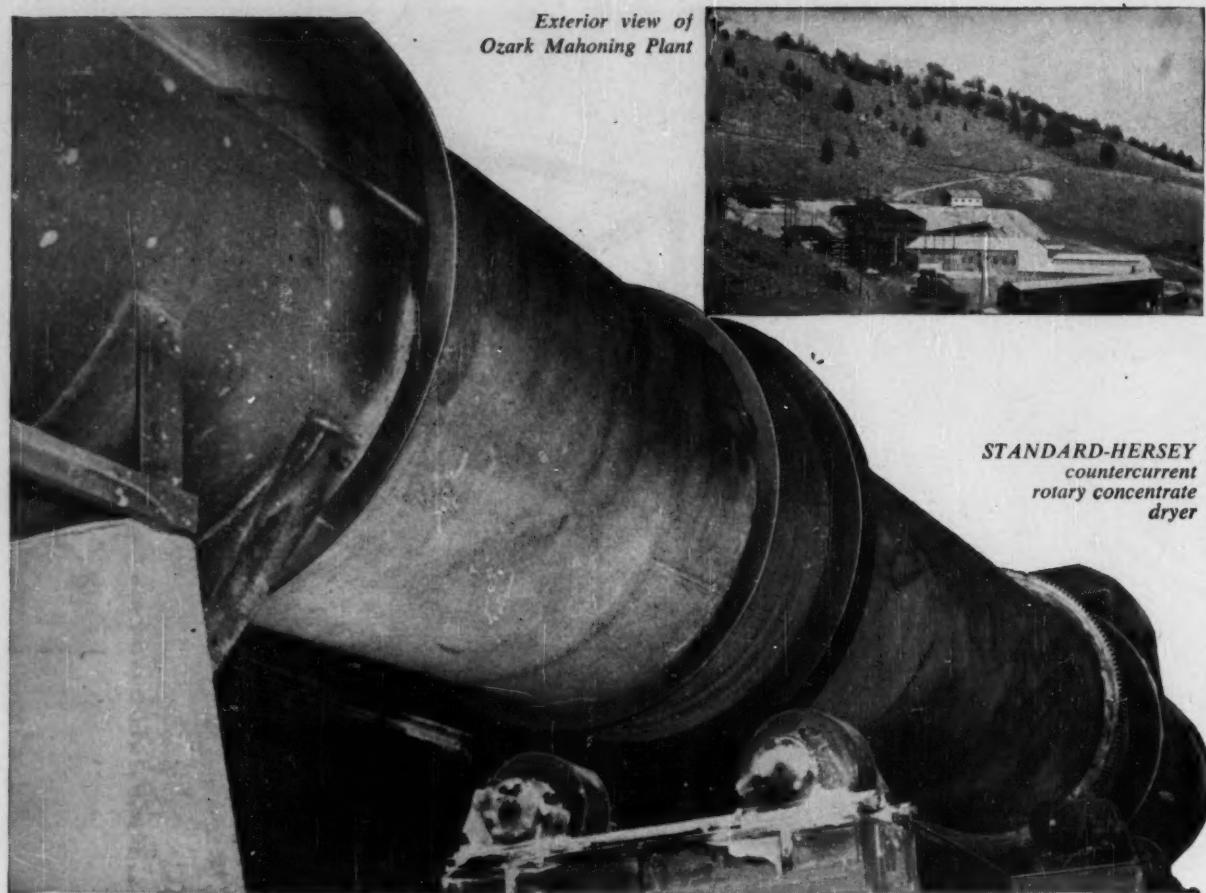
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SAN FRANCISCO

*Exterior view of Ozark Mahoning Plant*



**STANDARD-HERSEY**  
countercurrent  
rotary concentrate  
dryer



## FLUORSPAR CONCENTRATE DRIED TO ALMOST 0% MOISTURE BY A

**STANDARD HERSEY**  
ROTARY DRYER

The Northgate, Colorado plant of Ozark Mahoning Co. produces Acid Grade Fluorspar exclusively. Since their flotation concentrator went into production in October of 1952, output has increased to the point where their Standard-Hersey dryer is now operating at 150% rated capacity.

The filter cake, produced in Denver equipment, is transported by screw conveyor to a stacking belt for stock piling and

sampling, or directly into the 6' by 50' Standard-Hersey countercurrent rotary dryer. Moisture in the concentrate is reduced by the dryer from 12-14% to approximately 0% for shipment.

The dryer is lined throughout its length with refractories, as is the dryer furnace. Exhaust gasses at 350°F. pass through a cyclone type dry dust collection system with a balanced airlock arrangement. The temperature of the discharge product is 450°F. Semi-automatic burner controls provide efficient operation of the dryer unit.

The unusually large diameter of the dryer was selected to minimize the velocity of the gas stream through the dryer thus reducing concentrate dust loss to an estimated 1-ton of concentrate per 24 hours.

The engineering staff of the 52 year old Standard Steel Corporation has thousands of successful dryer applications to draw on in solving your problems. Over 30 types of dryers are available to fill almost every drying need in the chemical and food fields.

**SEND FOR FREE 12-PAGE ILLUSTRATED BULLETIN**

Learn how STANDARD-HERSEY has aided manufacturers throughout the world in solving their dryer problems.

THE STANDARD  
FOR 52 YEARS



**COMPLETE PILOT PLANT TAKES**

**GUESSWORK OUT OF DRYING**

STANDARD-HERSEY'S pilot dryers play an important part in solving your drying problems before blueprint stage.



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DF-3

# USE STRAINERS?

## USE YARWAYS



■ Use pipeline strainers in your plant? If so, you've plenty of reasons for using YARWAY Fine Screen Strainers.

Some of the reasons are these:

- Available in *iron or steel* with rust-resistant finish, also *bronze, stainless steel and aluminum*.
- Dutch weave Monel woven wire screens have high mechanical strength, extra fine straining service. Also perforated bronze, monel or stainless steel.
- Easy to remove screen caps with straight threads to assure proper alignment of screen.
- 10 standard sizes from  $\frac{1}{4}$ " to 3". Larger sizes to order. Also flanged and socket-weld connections.
- Stocked and sold by over 300 industrial distributors in the United States, Canada and abroad.

Write today for YARWAY Strainer Bulletin S-204, and name of nearest distributor.

**YARNALL-WARING COMPANY**  
137 Mermaid Avenue, Philadelphia 18, Pa.



### SCREEN EASILY REMOVED

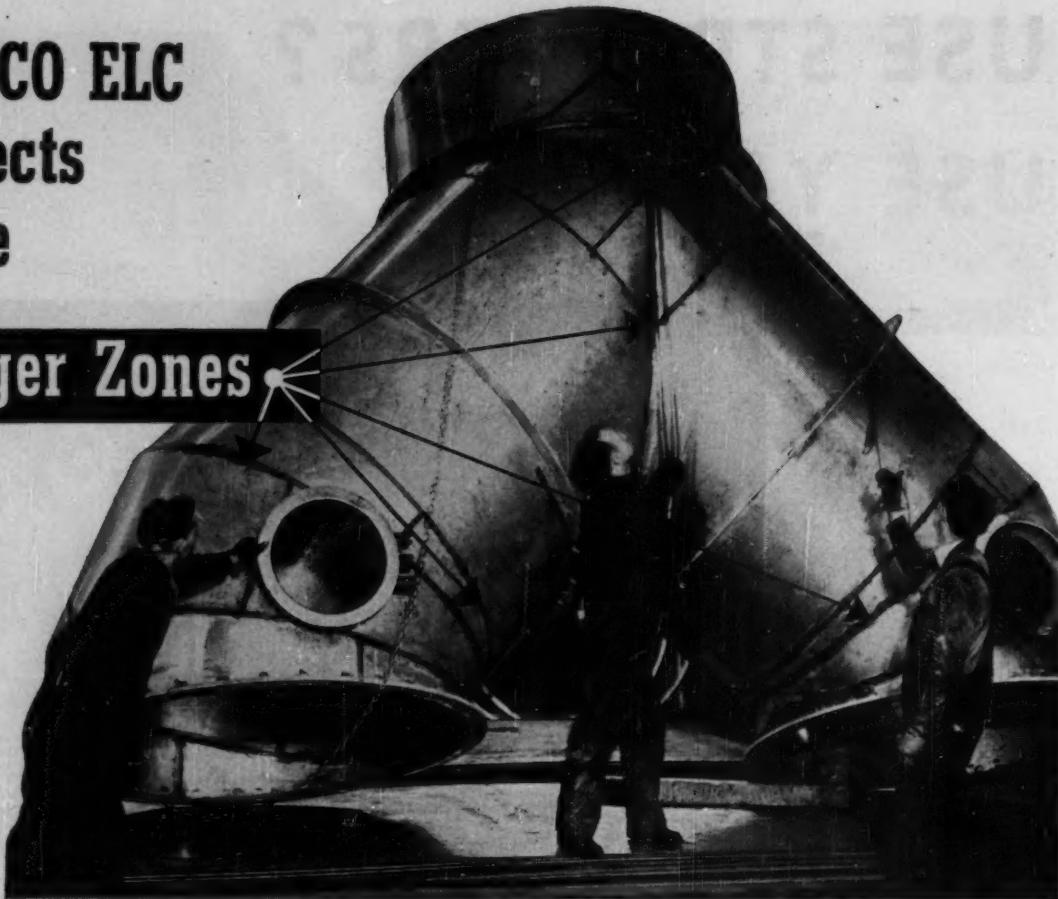
Unscrew cap and screen comes out with it. When replacing, put screen in cap, then screw cap into body. Straight threads assure correct alignment, no screen distortion. Cap is tapped for pipe plug or blow-off line.

# YARWAY

## FINE SCREEN STRAINERS

# ARMCO ELC protects these

## Danger Zones



There are no corrosion "danger zones" alongside welds when you use Armco ELC Stainless Steels. ELC means "extra-low carbon"—a maximum of only 0.03 per cent, too little to cause harmful carbide precipitation adjacent to welds during the welding operation.

Moreover, Armco 18-8 ELC (Type 304L) and Armco 18-12 Mo ELC (Type 316L) are lower in cost than their corresponding stabilized types. Yet the Armco ELC grades are equally resistant to intergranular corrosion in the as-welded condition in service at temperatures below 800 F.

### No Anneal Needed

For severely corrosive service, non-stabilized types of stainless steel like 304 and 316 must be annealed after welding. This is to dissolve the chromium carbides precipi-

tated during welding. Such an anneal is not needed with the ELC types. This makes the Armco ELC grades ideal for field assemblies and repairs.

### Write for Booklet

If you are not already acquainted with the Armco ELC Stainless Steels, why not fill out and mail the attached coupon. We will send you a copy of the booklet, "Armco's ELC Stainless Steels." Or, if you want complete information on Armco Stainless Steel sheets, strip, plates, bars and wire, ask for the catalog, "Armco Stainless Steels."



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Send me a copy of "Armco's ELC Stainless Steels"  
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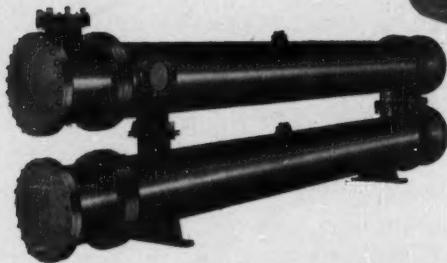
## Armco Steel Corporation

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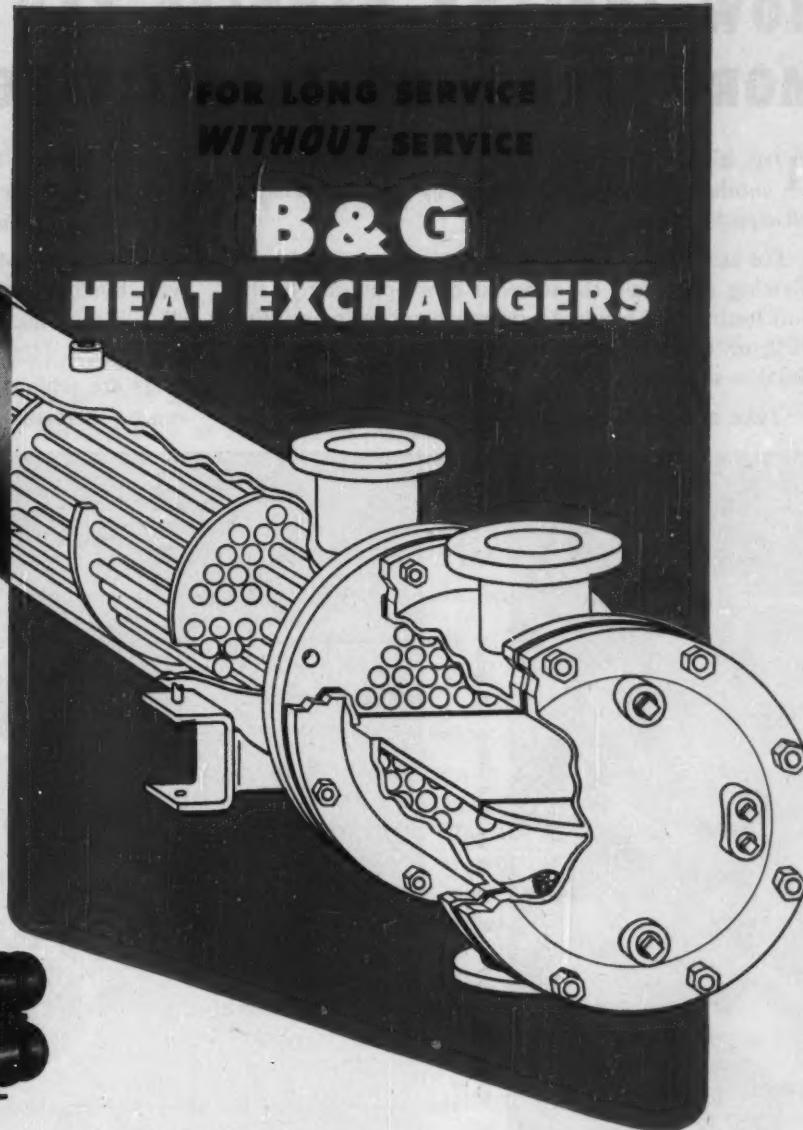


Two single pass, channel head B & G Heat Exchangers for series operation



B & G Heat Exchanger with U-bend tubing

For additional information on B & G Heat Exchangers send for Catalog DM-1150.



B & G shell and tube Heat Exchangers give you more value per dollar because they are built that way!

Basically efficient in design, these units are offered with straight and U-bend tubing. Ample material thicknesses in every detail and high tensile strength bolting are assurance of lasting strength and long operating life. Full tube bundles and close tolerances between shell wall and baffles prevent slippage of fluid and assure maximum heat transfer. Units can be furnished with tubing of copper, steel, several of the stainless steels and other non-ferrous alloys.

B & G Heat Exchangers are built to ASME Code U-69 requirements and can be certified by Hartford Steam Boiler and Inspection Service.

Whatever your heat exchange problems may be, remember that the B & G engineering staff is always available for consultation.



**BELL & GOSSETT**  
COMPANY

Dept. DS-14, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto, Canada

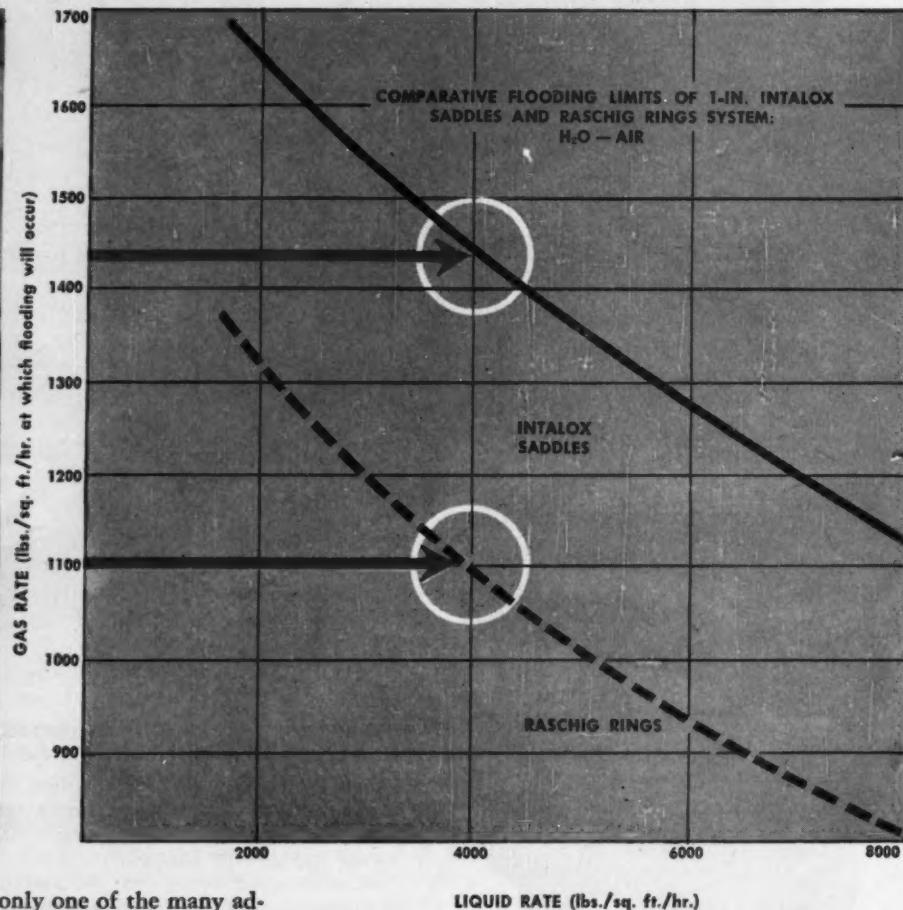
# HOW INTALOX SADDLES CAN ADD 30% OR MORE SCRUBBING CAPACITY TO YOUR TOWER

THE higher flooding limits of Intalox saddles offer another convincing factor in any study of relative efficiencies.

For example — if your present tower is packed with Raschig rings, and the tower is now operating to the full limit of its capacity, you can increase its capacity 30% or more by replacing the Raschig rings with Intalox saddles.

Take a look at the chart below showing the com-

parative flooding limits of 1-in. Raschig rings and 1-in. Intalox saddles at various liquid and gas rates. It was prepared from data based on repeated observations by independent authorities. Suppose a tower packed with Raschig rings is operated at a fixed liquid rate of, say 4000 lbs./sq. ft./hr. Flooding will occur at a gas rate of 1100 lbs./sq. ft./hr. But if the Raschig rings are replaced with Intalox saddles, the gas rate can be increased to almost 1450 lbs./sq. ft./hr.



Higher flooding limits are only one of the many advantages you obtain with Intalox saddles. The unique, patented "shape" results in a packed bed of greater randomness. There is more surface area per cubic foot, and even more important, virtually all surface area is effective area. There is more free space, and the free space is more uniform.

*It will pay you well to learn more about Intalox Saddle packing and how it can help you reduce tower construction and operating costs. Write for Bulletin IS-29.*



15%

## THE UNITED STATES STONWARE CO.

Process Equipment Division

NEW YORK

CHICAGO

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HOUSTON

JANUARY  
1955

# Chementator

Edward T. Thompson

- To get captive raw materials, and thus cut production costs for its barium products, Barium and Chemicals, Inc., plans to make barium carbonate from sulfate at a new Painesville, Ohio, plant.
- Dumping of European-made potash here at less than "fair value" has been discovered by the Treasury Dept. One case involving East Germany has already gone to the Tariff Commission. If ruled harmful to domestic producers, compensating duties could be added.

## New way to pentachlorophenol

By March, Reichhold Chemicals expects to be producing technical grade pentachlorophenol from a new 6 million lb. per year plant in Seattle—the first in the West. They'll be using a new process that's now being pilot planted in a 30,000 lb. per month unit in Seattle and on which the company has been working since 1947.

Essentially the process is two-stage chlorination. Trichlorophenol is chlorinated to penta with free chlorine and catalyst in the first reactor with a 95% yield. The remaining 5% stays in the reactor as residue, eliminating the need for refining the product.

Off-gases from the first reactor go to a second vessel where they're scrubbed with phenol to convert unused chlorine to trichlorophenol for recycle to the first reactor. Byproduct HCl is then stripped to recover chlorine for recycle.

## Oil firm to try gamma radiation reactions

Standard Oil Development Co. is prepared to plunk down \$5-20 million in development work should a million dollar gamma radiation research program it's initiating prove fruitful.

SOD's hope is to add gamma radiation to the list of activators for process reactions—both chemical and petroleum—supplementing or even supplanting such initiators as temperature, pressure, ultraviolet and catalysts. Early experimental work will be done at a new \$250,000 Linden, N. J., laboratory which will open in April.

First in priority, naturally, are new and better ways to produce gasoline, lube oils and other oil products. It's reasonable to assume, for instance, that catalytic cracking might be carried out without a dispersed phase catalyst—if gamma can initiate the reaction—and at much reduced temperature and pressure.

Polymerizations that can use gamma as the initiator are already known, and the light hydrocarbons will certainly be in for some study by Jersey scientists. New polymers—or cheaper ways to make known ones—might find important outlets in synthetic rubber, paints and oil additives.

For the initial research SOD will use a radioactive cobalt pipe now cooking at Brookhaven National Laboratory. It's been undergoing neutron bombardment in an atomic pile for over 2½ years, will have a source strength of 3,500-4,000 curies at time of delivery (cost: \$17,-18,000).

But Esso is looking forward to the time when cheaper radiation sources become available. Included are radioactive byproducts of atomic reactor operations, which AEC now buries underground, and possibly even the gamma rays now dissipated into shields surrounding atomic reactors.

## Ammonia via coke oven gas nears reality

Two companies' plans to use coke oven gas as a source of hydrogen for anhydrous ammonia production are rapidly nearing completion (see Chem. Eng., Sept. 1954, p. 114).

Blaw Knox has just about finished engineering

## CHEMENATOR . . .

design of an \$18 million, 200 ton a day unit to be built at U. S. Steel's Geneva, Utah, plant. Construction is set to start early this year, production in mid-1956. And it's highly likely that the firm will build a similar unit at Gary, Ind.

Also expected to start up in 1956 is a 120 ton per day plant at Ketona, Ala. It will be operated by Ketona Chemical Co. (a joint venture of Hercules Powder and Alabama By-Products) and will use a low-temperature process to obtain its hydrogen. L'Air Liquide is supplying equipment, Singmaster & Breyer is doing the design.

There's been no official word yet on what hydrogen recovery process U. S. Steel will use except that it will probably be based on a "German-Linde" patent. This points directly at low-temperature fractionation. Other ways under study are partial oxidation and steam-methane reforming.

But no matter which of these methods is chosen, the other processing steps are pretty well fixed.

Coke oven gas—about 50% H<sub>2</sub>—will be treated in the conventional way to recover such valuable byproducts as benzene, toluene and pyridine, then passed through sulfuric acid to produce ammonium sulfate. But instead of burning the remaining gases for fuel, as is now done, U. S. Steel and Ketona will recover hydrogen. This will be mixed with nitrogen and converted to ammonia. (U. S. Steel will also make some ammonium nitrate.)

When a low temperature route is followed, you're left with residual gas that's still good for fuel use. In addition, other fractions, such as ethylene, can be recovered during the fractionation. With partial oxidation and steam reforming, hydrocarbons left in the gas after the recovery of benzene, etc., are converted to hydrogen for maximum ammonia production. But no fuel gas is left.

### Look for more grants to researchers

A boom in research grants may be shaping up based on swiftly moving changes in tax rules.

First, Congress ordered a change in the law. Grants to researchers up to \$300 a month, for 36 months, aren't taxable as income anymore. On top of that the U. S. Tax Court in New York recently ruled that a grant made even under the old law should be considered a gift, instead of income as the Internal Revenue Bureau had ruled.

There is one catch, though. Under both the new law and the court ruling, grants must be made by tax-free, non-profit organizations. But government officials fully expect profit-making businesses to establish a growing number of foundations so

that more liberal tax treatment can be handed out freely to researchers.

Tax officials may appeal the court's decision. Before they decide, though, they're digging into the new law, which is broader than the court ruling, believing it may have solved the issue.

Researchers who paid taxes on grants under the old ruling are already asking about refunds. If an appeal is made, no refunds will be given until the matter is finally settled by the Supreme Court. But if Internal Revenue gives up the fight, applications for refunds made within three years of paying the tax may be approved.

### Rubber plant disposal looks brighter

The Monday after Christmas 1954 is a day that will be a milestone—either in getting the government out of business competition or in keeping it in. For that's the contract signing deadline for the commission charged with selling the 26 butadiene, styrene, GR-S and butyl rubber plants that make up the government's synthetic rubber monopoly.

And it marks the end of seven months of negotiations that were something of a milestone themselves for recognition of business management principles by the federal government.

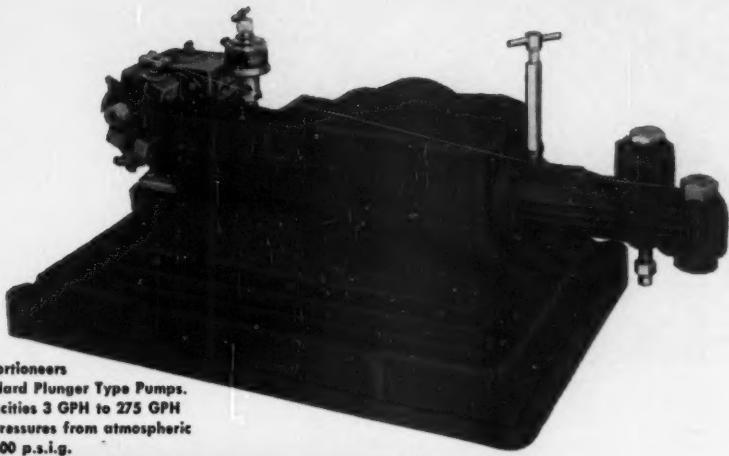
The main criterion used by the disposal group in setting target prices for each plant was the businessman's usual one—potential earning power. And in picking this—rather than total cost, unrecovered cost, depreciated value or book value—the group picked a figure that will be easiest to justify when the disposal "package" goes to Congress for final okay on Jan. 27.

Such justification will be important, too, since one of the four rules laid down when Congress authorized the program in 1953 was that the government receive "full, fair value" for plants. The other three—maintaining adequate supplies for national defense, assurance of rubber supply for small businesses, and promotion of competition—won't be so hard to meet.

Who gets the plants will be made public as contracts are signed, though prices won't be revealed until Congress gets the full report. And the commission plans to justify, in detail, the agreed price for every plant.

(As we go to press, four firms are rumored to be just about signed up: Goodrich-Gulf Chemicals, Copolymer Corp., Shell Chemical and American Synthetic Rubber Corp.)

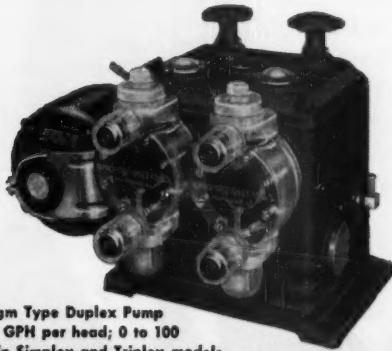
(Continued on page 104)



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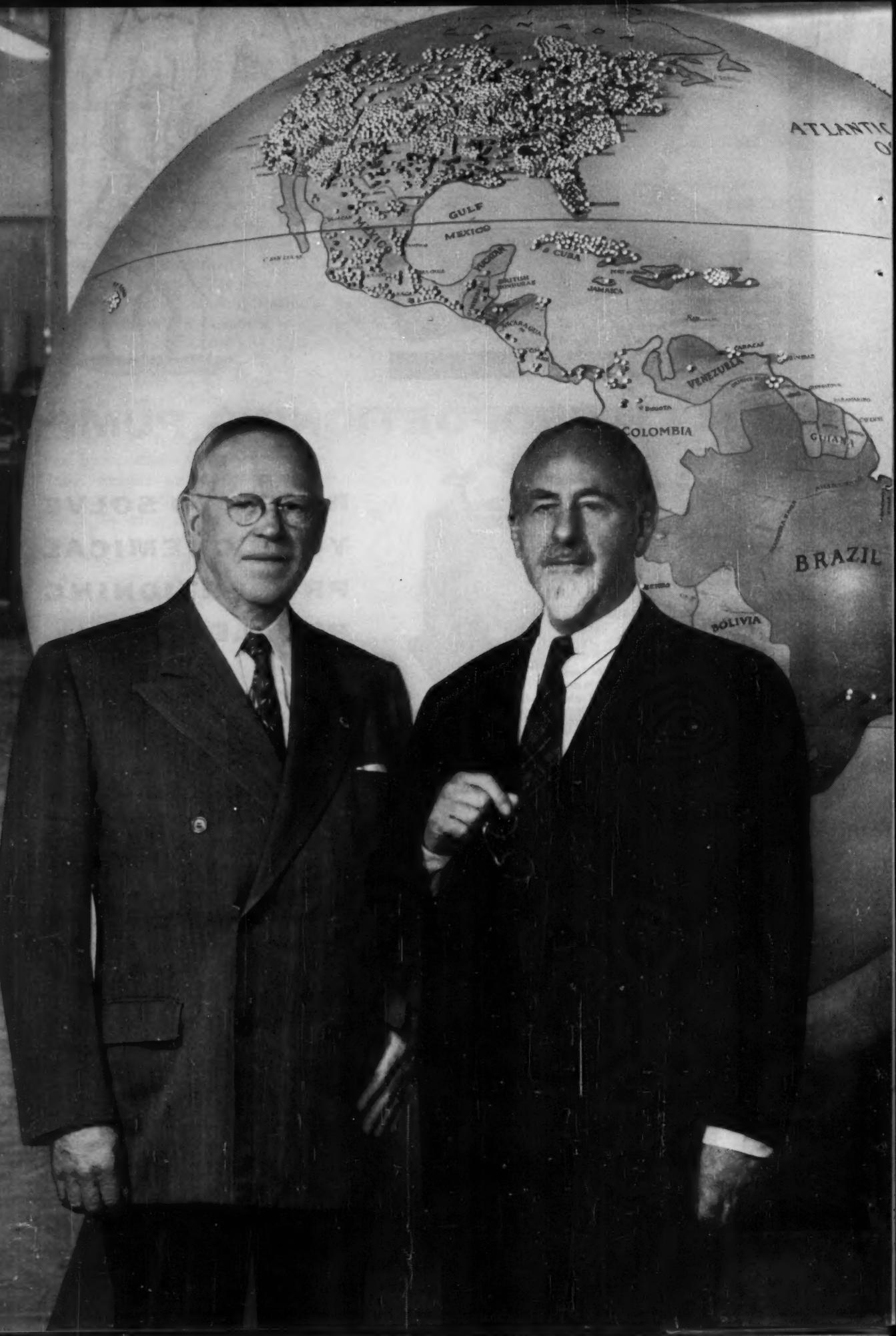


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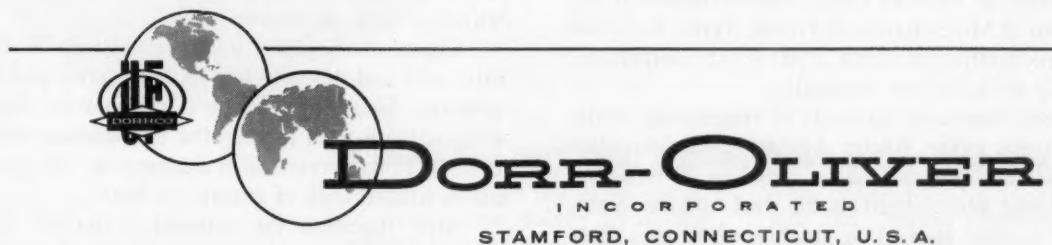


ON January first of this year, Dorr-Oliver Incorporated became a corporate entity through the merger of The Dorr Company, Engineers and Oliver United Filters Incorporated. Not a merger in name only, the combined staffs, engineering skills and facilities of the two organizations are being welded into a single unit, with a vastly increased capacity to serve on a worldwide basis.

Both companies have their roots in gold ore metallurgy. The Dorr Company was founded by John Van Nostrand Dorr on his early inventions, the first of which was developed in 1904 to solve the problem of mechanical classification of gold ores. Oliver United had its beginning in 1907 with

the development of the first successful continuous vacuum filter by Edwin Letts Oliver and its practical application to the cyanide process. Since their inception, both companies have grown steadily in technical stature to positions of leadership in their ever-widening and complementary, fields.

This cumulative, combined experience . . . coupled with a progressive faith in the future . . . is the strength of Dorr-Oliver. For present and future clients alike throughout the world it means better solutions to process problems in those fields of metallurgical, chemical, industrial and sanitational engineering in which Dorr and Oliver have specialized for nearly half a century.



Edwin Letts Oliver, Founder and President of Oliver United Filters, at left and John Van Nostrand Dorr, Founder and Chairman of the Board of The Dorr Company, at right. The globe, long symbolic of worldwide operations, stands in the home office of the new corporation in Stamford, Connecticut.

## CHEMINTATOR . . .

One possible stumbling block that's been bandied about a lot is that the new Democratic Congress may junk the whole deal. But actually there's little likelihood of that since it is generally a bi-partisan measure. The core of liberal Democrats who have labeled the program a "Republican giveaway" will probably still oppose it. But, if the price is right, they'll be a rather small minority.

On the other hand, until April 27 either the Senate or House could veto all or any part of the sale. If single sales are voided, any other bidder may withdraw. The whole program would be scrapped if, after such withdrawal, capacity of plants to be sold ends up less than 500,000 long tons of GR-S plus 43,000 long tons of butyl.

### Synthetic mica's nearly here

First commercial production of synthetic mica will begin this month at Synthetic Mica Corp.'s new plant in Caldwell Township, N. J. Anticipated capacity of the five-furnace unit is 1,000 tons a year—over 10% of current U. S. imports.

For industry this means less importing from India, only major source of high grade mica upon which so many electric-electronic devices depend.

Equally important, the synthetic (fluor-phlogopite) is as good as natural in most qualities, substantially better in some. Thus in addition to being a replacement it may well open up some brand new markets for mica.

The process to be used by Synthetic Mica (a subsidiary of Mycalex Corp.) was developed at the Bureau of Mines station in Norris, Tenn. It entails electric melting at about 2,500 F. of inexpensive, readily available raw materials.

Stoichiometric amounts of magnesium oxide, aluminum oxide, silicon dioxide, potassium silica fluoride and potash feldspar (totaling 20 tons) are dry-mixed and charged to the steel furnace. Sixty-cycle current applied to graphite electrodes starts the melting at the core. In about seven hours the resistor burns out, power is increased to 2,000 amp. and current passes through the melt itself, generating heat to maintain melting.

Melting is stopped after about 80 hours and the mass is allowed to cool for 7-12 days. The outside metal shell and unmelted material are removed. Finally, a shell of sintered mica powder is cracked away, leaving crystalline pig.

Mica crystals from the pig are 1/16 in. thick and up to 4 sq. in. in area. Main use will be in glass bonded products for now. But high hopes are held for use in reconstituted sheet that will withstand much higher temperatures than natural sheets.

Ground powder from the sintered shell could also be formulated into glass bonded products.

Crystal yield per batch is about 50%. But by recharging unmelted raw material and sinter an over-all yield of 95% is achieved.

### More Canadian pulp production expected

Recent purchase by Rayonier Corp. of an 80% interest in Alaska Pine and Cellulose, Ltd., of Vancouver may well open up important new markets for Alaska Pine. According to Leon Koerner, chairman of the Canadian firm, the \$20 million sale was specifically made to "develop British Columbia dissolving pulp production" by joining forces with an American company with large research facilities and well developed markets.

Huge logging interests are involved. Alaska Pine holds more than 8 billion board feet of timber under lease or license from the British Columbia government. Its 1953 cut of 400 million board feet was second biggest in the province and just under 10% of the total B. C. cut.

### Big claims made for nitric acid pulping

Although it's been tried a number of times, use of nitric acid to make paper pulp has never been commercially successful. Now, though, a French process called Delbay is said not only to work but to cut costs all along the line. And any cellulosic material can be processed continuously—hard or soft wood (including bark and branches if desired), straw or bagasse.

Charge stock is first mixed with about 30 Be. nitric acid and digested for 3-4 hours with paddle agitation. Since the reaction is exothermic, slight refrigeration is used to keep the temperature down to 60-70 F. to prevent fiber destruction. No pressure is needed and, of course, no heat.

After digestion the material is drained and washed with water (about 700 gal./ton of pulp). A nitro-lignin product with some fertilizer value is precipitated and filtered from the wash water, leaving plant waste very clean, minimizing stream pollution. Cold 1½% caustic is then added and neutralization is completed in 3-4 minutes. Since the solution is so weak, soda recovery is eliminated. Chlorine bleaching is the final step.

Pulp yield, say the inventors, is about 50% with most raw materials. And paper made from the pulp (any kind but kraft) is as good or better than that made from sulfite pulp. Chemical consump-

(Continued on page 106)

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## CHEMICALATOR . . .

tion is low, too. Per ton of bleached pulp the Delbay process uses 300 lb. of acid, 30 lb. of caustic soda and 60 lb. of chlorine.

Because only simple equipment is needed, even though it must be stainless steel, big investment savings are also cited. In France plant cost will be about \$35,000 per daily ton of pulp. Standard processes in France require \$60-85,000 per daily ton. U. S. costs for good sulfite pulp are in the \$60,000 range.

Full substantiation of these broad claims, which are based on pilot plant work, is expected by backers of the process early next fall. At that time a 20 ton per day unit is scheduled to start processing wheat straw into pulp in northern France. But even now the American representative, the Council on Public Relations, New York, is trying to interest U. S. firms.

It looks like they'll have to do plenty of convincing, too. U. S. experts are already voicing skepticism, based mostly on the doubt that a 3-4 hr. digestion of wood chips in nitric acid at atmospheric pressure can do the job.

As for the ability to use wood with the bark still on, branches or such materials as straw, the feeling is that that's not too important in this country. Debarking, for example, is no longer excessively costly and serves an important function just by assuring a clean charge material.

But despite these reservations, U. S. paper men definitely are watching this development with interest, though not with high hopes.

### Huge spending program urged to lick smog

Revolutionary in its size and scope, a new \$2.2 million anti-smog research program for 1955 has been proposed for Los Angeles County by the Southern California Air Pollution Foundation. Significantly, it's the first real attempt to coordinate the efforts of all agencies working on the smog problem.

Stated aim of the program, which was submitted to the County Board of Supervisors by request, is to combat smog on both emergency and long-range bases. And because the most desirable ultimate solutions will probably take several years to achieve, stop-gap measures are high in priority.

Typical of the many proposed studies are:

- Clearer identification of the contributors and contaminants.
- Feasibility of using nonleaded gasoline and a catalytic converter for automobile exhausts.
- The more difficult job of developing a converter for the leaded gasolines now in use.

- Possibility of using other automotive fuels, such as liquified petroleum gas or blends of alcohol and gasoline.

If the Supervisors accept the program, they will give their blessing to the Foundation for its part (\$702,350, contributed by industry), they will get county-financed programs (\$986,550) underway, and they will appeal to the state and federal governments to do their suggested parts (\$435,500 and \$90,000, respectively). Hence, four currently independent groups would concentrate on one program to control and prevent air pollution.

### Carbon fission: Is it possible?

Scoffed at by nuclear scientists as being fantastic, a new theory that promises an 8,000 times boost in the useable power from coal and other carbonaceous fuels is going to be tested.

Fairchild Engine and Airplane Corp., one of the world's largest aircraft makers, has retained the inventor, Col. Harry Hardsog (U. S. Army, ret.), as a consultant. He'll be installed in a laboratory at Northboro, Mass., where Fairchild engineers will try to evaluate the process.

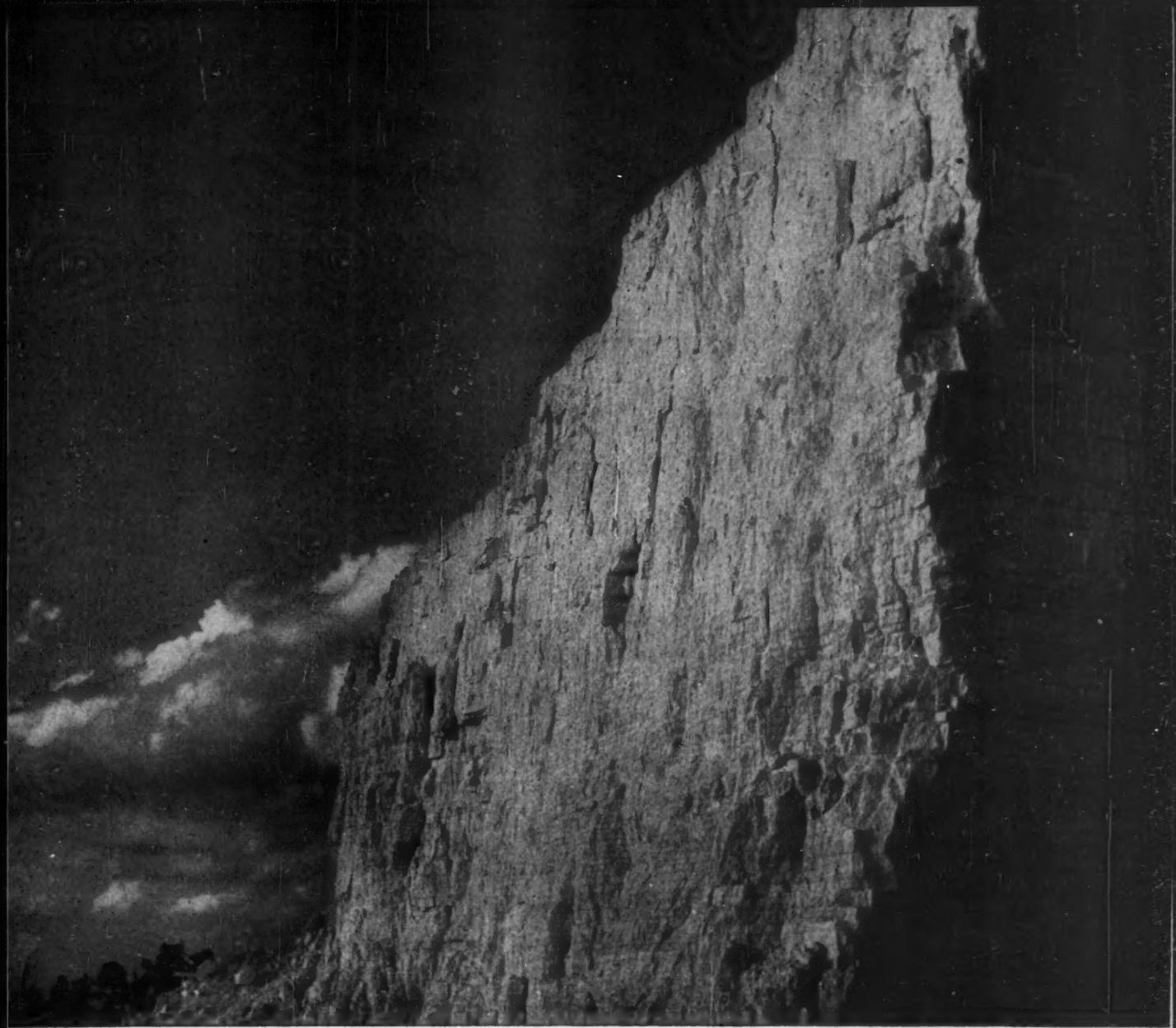
Hardsog claims the carbon atom can be excited by upsetting the internal energy balance to release tremendous energy. To give an idea of the potential significance, burning one pound of coal releases about 10,200 Btu.; the new process, which has been dubbed a "quantum jump," would release more than 78 million Btu.

(One possible reaction form, says Hardsog: a carbon atom is excited, breaking into one atom of hydrogen and one of boron, plus 16 mev. of energy. Neither product is radioactive. Theoretically this would give nearly 56 billion Btu. from one pound of carbon. To use in present boilers or turbines, of course, controls would be needed to keep useable energy way below 1% efficiency due to the inadequacy of construction materials.)

Neither Hardsog nor Fairchild knows now whether the process is practical or can be controlled. But in earlier tests under government auspices, one agency said this: "The invention, though not completely tested, has a reasonable chance of successful operation."

Industry's first reaction to this statement and to the whole Hardsog theory was overwhelmingly in the form of hoots and jeers. And even with a reputable firm like Fairchild deciding to take a good look at it, very few scientists put any stock in the scheme.

For more of WHAT'S HAPPENING . . . . 108



## Mathieson Sulphur: *from waste, a pile of gold*

This bright yellow mountain, nearly five stories high, was cast of sulphur reclaimed from purifying natural gas and petroleum refinery wastes by Mathieson-developed recovery processes. The raw sulphur, of extremely high quality, is stored in these huge piles prior to grinding and refining. When needed, it is blasted from the face and processed into the many grades of sulphur that Mathieson makes for industry and agriculture.

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JANUARY  
1955

# What's Happening

## Feature News This Month

|                                       |     |
|---------------------------------------|-----|
| Polyvinyl Alcohol Fiber . . . . .     | 108 |
| Air Pollution Tracing . . . . .       | 112 |
| Convention Calendar . . . . .         | 114 |
| Oil Refinery Expansion . . . . .      | 116 |
| High-Solids Spray Drying . . . . .    | 118 |
| New Pelletizing Process . . . . .     | 120 |
| Ion-Exchange Sugar Refining . . . . . | 122 |
| Pressure Drop in Big Lines . . . . .  | 126 |
| Research Expense Formula . . . . .    | 130 |
| Suspension Process PVC . . . . .      | 132 |

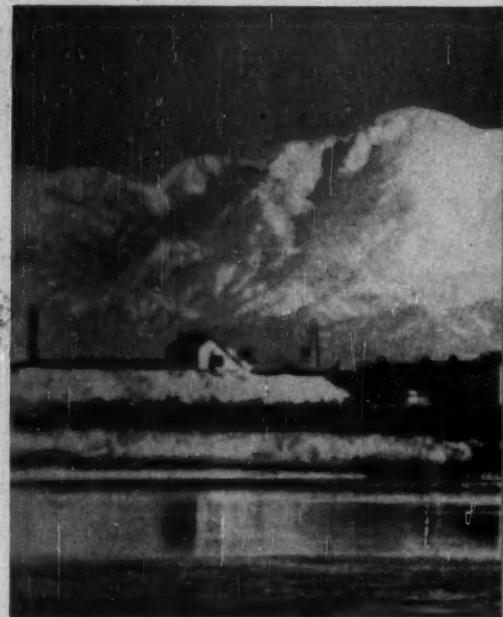
## Oldbury Starts Up Sodium Chlorate Plant

Under construction for two years, Oldbury Electro-Chemical's \$4 million sodium chlorate plant at Columbus, Miss., is now on stream.

Some design changes have been made, but the basic process hasn't changed. Brine is electrolyzed and the cell liquor purified and evaporated. Sodium chlorate produced is continually crystallized, then centrifuged, washed, dried and packaged.

Plant capacity is 12,000 tons a year. This is a major addition to the potential U. S. supply of sodium chlorate—now estimated to be 70,000 tons annually.

But whether there's a good market for all of it is open to question. According to Dept. of Commerce reports, 1953 production was only 43,221 tons. For most of 1954, production was down to an annual rate of only 36,500 tons. This indicates that some plants—and perhaps all of them—are operating well below design capacity.



## Polyvinyl Alcohol Vies for

You may not yet be able to buy a pair of polyvinyl alcohol socks in your favorite department store or dress your filter press with PVA cloths—unless you happen to live in Japan.

That's because Japan right now is the only country producing PVA fiber—known genetically as vinylon—on a commercial scale. But vinylon's attractive properties and potentially low price demand attention from the American and European synthetic fiber and textile industries.

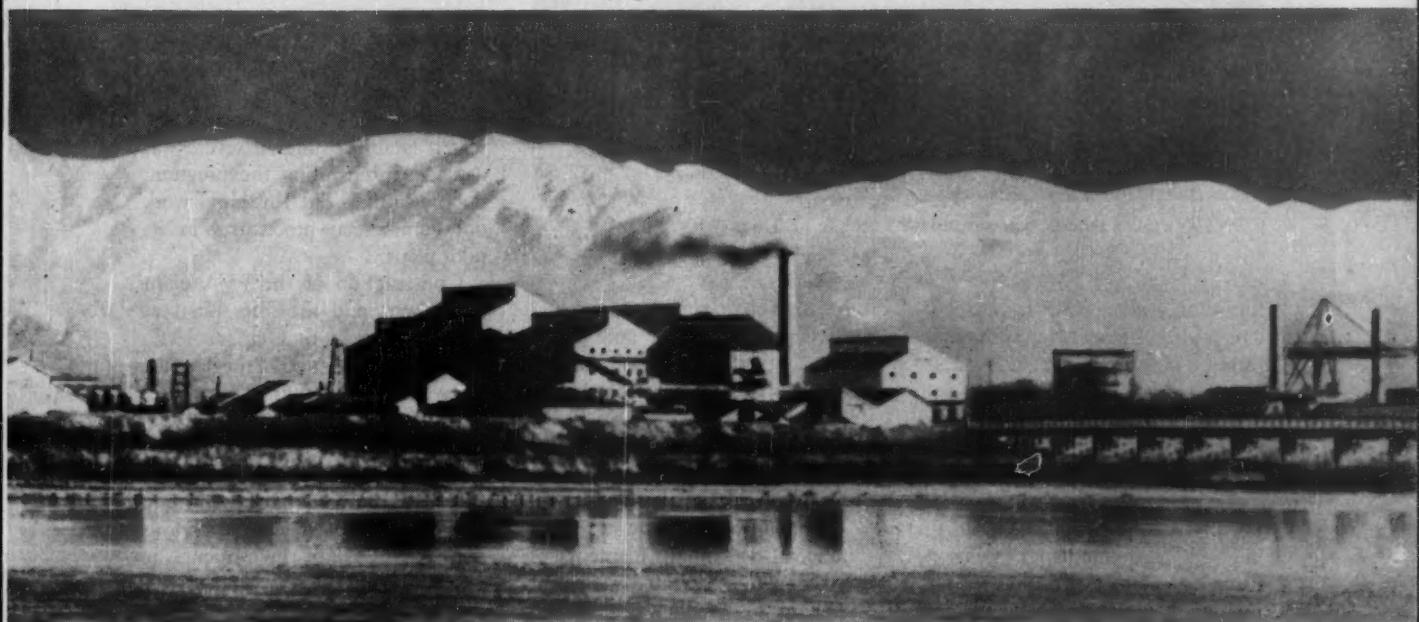
Commercially, vinylon is now four years old. Production in 1953

was 8.6 million lb., is soon due for a sharp boost. Kurashiki Rayon Co., biggest producer, has just completed a plant expansion program which upped its capacity from 8 tons per day to 20 tons per day. And according to plans of the Japanese government, the country's output of vinylon will reach 65 million lb. annually by 1957.\*

► **Price Competition**—Initial commercial price of vinylon was \$0.84

\* By way of comparison, here is the current estimated U. S. annual capacity for noncellulosic synthetic fibers: Nylon, 300 million lb.; acrylics, 90 million lb.; polyester (Dacron), 35 million lb.

# *in Chemical Engineering*



## Attention in World Synthetic Fiber Picture

per lb., is now \$0.70. Kurashiki Rayon plans to drop its price to \$0.50 shortly. "Final target of our vinylon fiber," says Kurashiki's Dr. Tsuzura Tomonari, "is to compete with cotton price-wise, and that target is not too far away now."

Tomonari figures that vinylon will take over a good hunk of cotton's market if selling price can drop to \$0.35. The projected huge capacity expansion puts such a price within reason.

► **Water Resistance**—Polyvinyl alcohol itself is soluble in hot water. This property is both a bane and a blessing—a bane, because you don't

want your vinylon shorts to disappear in the washtub; a blessing, because spinning from an aqueous solution is simple and cheap.

Objective of years of research on PVA fiber—which goes back a quarter of a century—has been to insolubilize the fiber after spinning. Investigators in Germany, England, U.S. and Japan have turned up a number of ways of doing this. Kurashiki's process involves the acetalization of the fiber with formaldehyde.

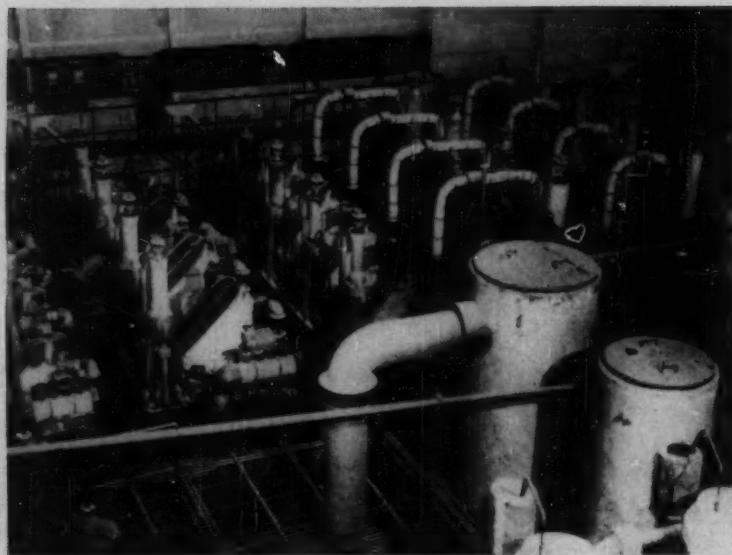
PVA's hydrophilic nature imparts to vinylon fiber a property unique among noncellulosics. Its

water absorbency is relatively high—about 30%. Vinylon can thus replace cotton in underwear, sheets and similar uses where the fiber is in contact with the body, while maintaining body comfort.

On the negative side of the ledger, damp ironing of vinylon goods is still a problem. Although intensive research has developed a fiber with a wet-heat resistance of 115-120 C., severe ironing, as with a cotton shirt, is a yet-to-be attained goal.

► **Making the Monomer and Polymer**—Kurashiki starts its operations at its Toyama plant with the syn-

## WHAT'S HAPPENING . . .



CONTINUOUS process polymerizes vinyl acetate at Toyama PVA plant.

thesis of vinyl acetate from acetylene and acetic acid by vapor-phase reaction over a zinc acetate catalyst. Unreacted acetylene and acetic acid are removed from the product and recycled; byproduct acetaldehyde is oxidized to acetic acid and reused.

Vinyl acetate is continuously polymerized into polyvinyl acetate in bulk and methanol solution, using a peroxide catalyst. The methanol solution of polyvinyl acetate is continuously hydrolyzed into polyvinyl alcohol by caustic soda. The PVA precipitate is filtered, washed with methanol and dried in the form of a white powder.

Filtrate separated from the product PVA contains methanol, methyl acetate and sodium acetate. These components are separated by distillation; the recovered methanol is reused, while the methyl acetate is hydrolyzed into methanol and acetic acid, and the sodium acetate is reacted with sulfuric acid to make acetic acid and glauber salt. The sodium acetate can also be electrolyzed to acetic acid and caustic soda. Methanol, acetic acid and caustic soda are all reused; the glauber salt is used for spinning.

► **Spinning the Polymer** — PVA moves from the Toyama plant over to another Kurashiki Rayon plant at Okayama for making the fiber.

The polymer is dissolved in warm

water to prepare the spinning solution, which is filtered and deaerated. The spinning solution is forced through the fine holes of spinnerets into a coagulating bath of glauber salt. The filaments are taken up from the bath over a godet wheel, like rayon spinning.

The spun tow, made up of a number of continuous filaments, is dried, drawn and treated with heat and chemicals, finally washed, oiled, dried and cut into staple. The chemical treatment, for imparting water resistance to the fiber, takes place in a bath containing formaldehyde,  $H_2SO_4$ , and glauber salt.

► **Bringing up PVA** — Vinylon traces its origin to Germany, where in 1924 Herrmann and Haehnel first made polyvinyl alcohol as part of their research program to create new substances from acetylene. In 1931 they disclosed the formation of PVA fiber in German and U. S. patents (U. S. 2,072,302). Their U. S. patent application antedates Carothers' application for nylon by about four months; vinylon may thus claim to be the first true synthetic fiber to be invented.

Small-scale production of a water-soluble PVA fiber began in Germany in 1934, but didn't get very far. Demand for a water-soluble fiber was not great.

Just about this time, Kurashiki

Rayon Co. got interested in the possibilities of making true synthetic fibers, although no such materials were on the market at that time. After several years of study, Kurashiki decided to attempt commercialization of a water-resistant PVA fiber. This decision was based largely on the fact that acetylene, basic raw material, could be made from available Japanese resources.

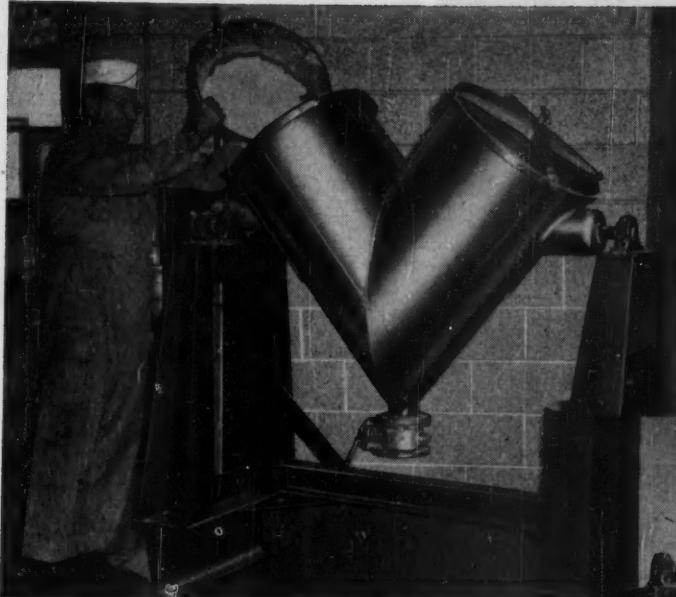
Research began in earnest in 1940, covering the entire commercial picture from wood distillation (to make charcoal for calcium carbide production) through polymer manufacture, fiber spinning and processing into textile goods. Research facilities suffered severe war damage, interrupting the program; not until 1948 did Kurashiki work out commercial procedures in its pilot plant.

Construction of the PVA plant at Toyama and the fiber plant at Okayama began in October 1949; commercial production began just one year later. A rate of 5 tons per day was reached in March 1951. Both plants were quickly expanded to 8 tons per day. Scale of operations was boosted during 1954 to a capacity by year-end of 20 tons per day. Total investment in vinylon facilities is now over \$10 million.

► **Look Into the Future** — Dr. Tomonari has made a close study of world textile consumption since 1890 and has projected the picture well into the future. According to his figures, by the year 2000 cotton will have only 35% of the total world market, wool and silk taking only 3.1%, rayon and acetate 20% and synthetics the rest, or 41.9%.

One important factor in this estimate is that cotton and wool production cannot keep up with increasing demands for textiles. What the world needs, says Tomonari, is not an expensive "miracle" fiber with limited applications, but a synthetic which can replace natural fibers price-wise and quality-wise.

This philosophy has been the basis of Kurashiki's determination to go ahead with commercialization of vinylon in spite of many difficulties. These efforts now seem to be getting their just reward.



Charging a p-k Twin Shell Blender through one of the two large access ports at O. M. Franklin Serum Co. plant in Denver, Colo.

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\*All quotations on this page are from a signed letter from Mr. Curyea to the Patterson-Kelley Company, Inc.

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<sup>†</sup>Patented

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**FLUORESCENT** powder dispersed into air at central point . . .

## Traces Pollution Patterns

Chemical engineers now have a powerful new tool to help solve problems in air pollution.

A simple, three-step tracer technique provides fast, reliable answers to the question: Where do pollutants go?

• First, a fluorescent dust is dispersed into the atmosphere from

a given point under carefully controlled conditions.

• The atmosphere is then sampled at any number of locations in the area with special filters.

• Finally, the filters are examined under ultraviolet light, and the degree of fluorescence is measured with the aid of a microscope.



**PATTERN** is plotted by sampling at scattered points.

Originally developed by researchers at Stanford University, this idea is being put to practical use by Ralph M. Parsons Co., Los Angeles engineering and construction firm. It is a part of the Southern California Air Pollution Foundation's current attack on the Los Angeles Basin smog problem.

► Gets the Basic Data—First step in solving any air-pollution problem is to find the source of the pollutants or, conversely, to chart the area of potential pollution from a known point source.

Certainly in many cases no one can deny that the air is being polluted. Where there are several likely pollution sources, however, attempts to pinpoint responsibility have usually met with failure.

On the other hand—and just as hard to establish—a company studying a new plant site needs to know the probable pattern its air-borne effluents will take. Such a study would indicate the suitability of the site and the need for any pollution-control equipment.

Studies of air currents and wind patterns alone will not supply the needed data. Influences of buildings, trees, topographic features, thermal effects and turbulent diffusion—all these limit the value of this type of data. Use of the tracer technique avoids these difficulties, provides a true picture of air-pollution conditions at the time of test. (The tracer technique cannot predict the path of pollutants under

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HOUSTON 12, TEXAS

RICHARD B. KAHLER  
PRESIDENT

March 16, 1954

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HOUSTON, TEXAS

Mr. George R. Brown  
Executive Vice President  
Brown & Root, Inc.  
P. O. Box 3  
Houston 1, Texas

Dear Mr. Brown:

The rehabilitation of our alkylation unit and its conversion from hydrofluoric to sulfuric catalyst type was completed by your people last month and put into immediate operation. The work was finished in a hundred and one working days from the date you were given the contract.

This work, I believe, sets a record in two cases: first, in time of completion; and, second, in the fact that the plant started up immediately upon completion, was gradually brought up to capacity, is running at more than designed capacity, is running at full designed specifications and has required no substantial change of the equipment as completed.

As I told you shortly after this job began, it was of great importance for us to finish it promptly and have it in operation at full capacity immediately upon completion. You personally stated that you would do everything you could to expedite the completion and that it would be a good job. You have certainly complied in both instances.

I want to thank you personally, and for my associates in the company, on the job you did for us and I wish you would convey to your associates who worked on this construction, our grateful appreciation and thanks.

Sincerely yours,

R. B. Kahle

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six months  
and a half-million  
barrels of gasoline**



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## WHAT'S HAPPENING . . .

meteorological conditions other than those existing during a particular test.)

► **Why Not Radioisotopes?**—Radioactive tracers can be used effectively for many measuring jobs (*Chem. Eng.*, Oct. 1954, p. 118). One method for charting a potential pollution pattern, for example, might be emission of radioactive sulfur dioxide from the particular point.

Where there is a large area to be covered, however, release of radioactive materials from a point source in quantities sufficient for effective coverage might involve certain hazards. And neighbors might easily find grounds for objecting to this method. Radioactive tracers, therefore, can be used only where the tests cover a relatively small area—say, a few square miles.

Use of colored smokes is another possibility. Disadvantages: Quantitative measurements are difficult, and the smokes are rapidly diluted to the point of invisibility where the study covers a large area.

► **Fluorescent Dust**—Parsons uses zinc cadmium sulfide particles in the 1 to 2 micron size range, cites these advantages for the method:

- The material is practically inert, relatively nonhygroscopic and not affected unduly by sunlight or temperature. It is of such a special nature that it is seldom found in contaminated areas; test results, therefore, are not biased because of factors beyond control.

- Since a characteristic of the material is its brilliant fluorescence under 3,000-Angstrom illumination, it is readily identified and easily counted.

- Collection techniques are simple and readily handled by persons with little training.

- Although the actual number of particles released is large, the total mass is so low that the dispersed particles can't be detected except with special instruments.

- Tests may be conducted without creating undue excitement on the part of either the local populace or authorities.

► **Disperser and Collector**—The dispersing unit, originally developed at Stanford University, uses a high-

### Convention Calendar

Fourth Conference on Scientific Manpower, sponsored by National Science Foundation, National Research Council, Engineering Manpower Commission and American Association for the Advancement of Science (in conjunction with annual meeting of the AAAS), Berkeley, Calif., Dec. 28-29.

Chemical Market Research Assn. and Commercial Chemical Development Assn., joint meeting, "Chemicals in Foods and Feeds," Edgewater Beach Hotel, Chicago, Jan. 20-21.

Engineers Joint Council, first General Assembly, Hotel Statler, New York, Jan. 21.

Plant Maintenance & Engineering Conference and Show, International Amphitheatre, Chicago, Jan. 24-26.

The 12th biennial International Heating and Ventilating Exposition, Commercial Museum and Convention Hall, Philadelphia, Jan. 24-28.

Chlorine Institute, annual meeting, The Biltmore, New York, Jan. 26.

Agricultural and Mechanical College of Texas (Texas A&M), symposium, "Instrumentation for the Process Industries," College Station, Tex., Jan. 26-28.

Society of the Plastics Industry, tenth annual Reinforced Plastics Division conference, Hotel Statler, Los Angeles, Feb. 8-10.

erage sensitivity of one particle per 600 liters of free air when sampled for a period of 1 hr.

► **Practical Value**—Parsons first developed its tracer technique as part of a contract with the government covering studies of meteorological conditions in several cities during 1952 and 1953. In this period the company made over 170 tests and analyzed more than 20,000 filters.

The present study in the Los Angeles area will provide data to help determine sources and paths of pollutants contributing to the area's severe smog problem. For example, the study will indicate for the first time whether under specified conditions pollutants do or do not travel from specific areas south of Los Angeles to certain other areas of the city. There are 25 sampling stations at key points over an arc of 50 miles.

City officials can use data from these and similar tests to develop a realistic zoning and control program, one which will impose on industry the least need for expensive control equipment and yet cause minimum nuisance to surrounding areas.

Parsons has also completed an investigation preliminary to setting up a tracer study of the effluents from a large chemical plant in the South that is the target of an increasing number of complaints from residents of the area. The specific problem is to find out the degree, if any, to which effluents of the plant are contributing to the pollution problem. The problem is complicated by the presence in the vicinity of several other chemical processing plants.

Cost of such a study might run as high as \$50,000, although less ambitious programs could easily cost only a fraction of that amount. On the other hand, complex studies could run far higher. Parsons points out that each individual study is essentially a custom job whose cost may vary over a wide range, depending on many factors.

Even \$50,000 might be money well spent, however, in terms of the more reliable data and improved public relations which it can buy via Parsons' tracing technique.

speed (11,000-rpm.) portable blower which delivers 200 cfm. at a nozzle velocity of about 70 ft. per sec. Provision is made for introducing the fluorescent powder at the blower inlet at rates as high as 3,000 grams per hr. About 55 billion particles are actually air-borne per gram of powder released.

For sampling, Parsons uses a Lovell Millipore filter on a magnetic-type holder. This filter has a high efficiency for trapping particles down to about 0.5 micron in diameter and retains them on the forward face so they may be optically observed and counted.

A flexible hose between the filter holder and pumping unit permits convenient placement of the two units. The usual pumping rate is 10 liters per min., providing an av-

## Louisville Method

# Louisville Dryer "Family" boosts production, cuts costs for chemical manufacturer

Dryer Types Installed  
in one Plant Since 1933



10 ft. x 100 ft. size  
largest ever built!

Pilot Dryer  
38 in. x 25 ft. size

Some years ago a large chemical company bought the smallest commercial Louisville Steam Tube Dryer as a pilot plant for a new product. Today this firm owns a whole "family" of Louisville Dryers, ranging from their original small pilot plant to the largest steam tube dryers ever built, Louisville's 10 ft. x 100 ft. rotary dryers.

Large or small, there's a *right* size dryer for your job. Louisville relieves you of guesswork about dryer size, type or construction. Our engineers survey your problem . . . their recommendations are job-tested in our pilot plant. Your Louisville Dryer is *built*—not assembled—and built right for your job. Its performance is backed by over 50 years of successful drying experience.

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## WHAT'S HAPPENING . . .

### Du Pont Neoprene Plant Delayed a Few Months

Though originally scheduled to be begun last fall, construction of Du Pont's Montague, Mich., neoprene plant won't get under way until this spring. Completion is now expected late in 1956.

The 1,000-acre plant site adjoins the Hooker Electrochemical Co. chlorine-caustic plant near Montague and the land on which Linde Air Products will build acetylene generating facilities. Hooker will supply Du Pont with hydrogen chloride and Linde will pipe in acetylene, the other major raw material for neoprene.

Du Pont's present neoprene output comes from its Louisville, Ky., plant where an expansion program is nearing completion.

### Brown Co. Selling Canadian Holdings

By divesting itself of certain Canadian assets, the Brown Co. of Berlin, N. H., will increase the equity per share of common stock from \$14.26 to over \$25. Brown is selling its Canadian subsidiary, Brown Corp., to Canadian International Paper Co., and its Canadian hydroelectric power interests to Shawinigan Water and Power Co., for a total of \$46 million. These are carried on Brown's books at only \$18 million.

Properties going to Canadian International include 2.5 million acres of woodland and a pulp mill at La Tuque, Quebec. Shawinigan will get Brown's half interest in St. Maurice Power Corp.

The sale will not curtail any of Brown's American operations. Rather, the company is already planning extensive improvements and additions in this country.

### Industry to Be Briefed On Scientific Advances

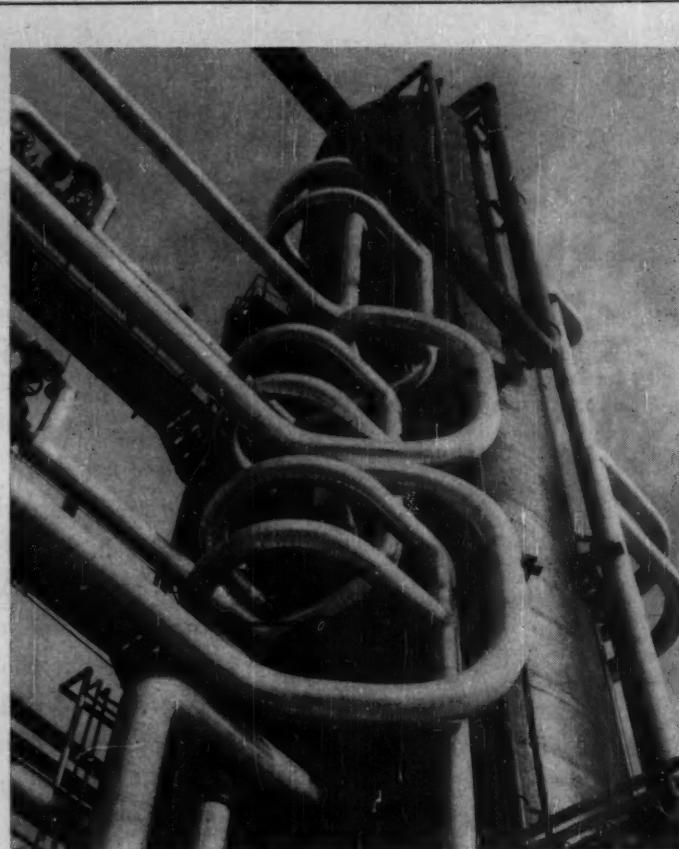
A new program at the University of Michigan, known as the Industrial Program, is expected to open up direct channels of communica-

tion between industry and the University's College of Engineering. Subscribing companies will receive information on the College's latest engineering and scientific advances at a nominal cost. Also, University and industrial experts will meet periodically to review fields of mutual interest.

The program is the first of its kind to be made available to industry on a broad basis. And so that many firms can participate, fees are kept purposely low—\$5,000 a year for a period of three years, about one-fourth the cost of one

technical man in an industrial research laboratory.

Small companies will be supplied with data they are unable to develop themselves. Large firms will be kept informed of work in fields in which they are especially interested but are unable to explore fully. One of the plan's most important features, says Dean George Brown of the College, is advance distribution of the results of research programs, since publication of material in technical journals often lags a year or more behind the actual work.



Major oil expansion nears completion

Through the maze of pipes on this crude oil topping unit, petroleum intermediates are now flowing to new vacuum and hydroformer feed preparation units at the Lake Charles, La., refinery of Cities Service Co. A third major unit, a hydroformer, will be on stream

soon. Also included in the program is a de-ethanizer to increase recovery of propylene for aviation gasoline production.

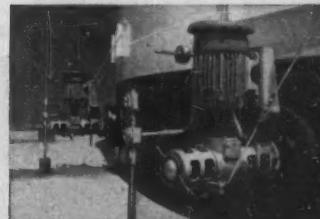
The complete expansion, which is costing \$22 million, will up the refinery's capacity by 10%—to 20,000 bpd.



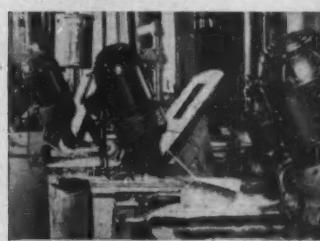
**IF THIS HAPPENS** in your plant, will you have to junk the entire mixer because of ruined gears, bearings, and other parts? Mixer gears can wear out fast—unless they're protected from continuous buffeting of tank liquids, as well as from accidents. See below.



TOP ENTERING...turbine and paddle types. Sizes 1 to 500 HP.



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## Even an ACCIDENT can't hurt the gears in this fluid mixer!

Specify LIGHTNIN Turbine or Paddle Mixers—and you'll never have to worry about shaft flexure being transmitted to the gears of the speed reducer.

Even if one of your operators accidentally drops a sack of solid material into the tank while the mixer is running, the shock load never gets back to the vital parts of the mixer drive.

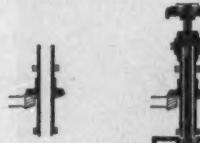
Notice how the mixer shaft passes through the hollow quill of the speed reducer.

See how the mixer shaft and hollow quill are connected at only *one* point—by a flexible coupling. The coupling soaks up all the strain...isolates and protects the gearing.

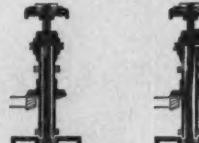
That's one *big* reason why you get

years and years of trouble-free, low-cost operation with LIGHTNIN Mixers.

There are many more good reasons



1. SPEED REDUCER GEARS are protected in LIGHTNIN Mixers by this hollow-quill construction. Driven by gears, the quill shaft turns on its own heavy-duty bearings.



2. MIXER SHAFT passes through the hollow quill. Shaft turns on its own separate bearings. Shaft and quill are connected by a torsionally resilient flexible coupling (arrow).



3. SHAFT FLEX (greatly exaggerated here) can never reach gears, bearings, and other parts of speed reducer. All shock loads and stresses are absorbed by the flexible coupling.

why you cut costs with LIGHTNINS. Versatility, for example. The turbine-type LIGHTNIN Mixer you buy today can keep on serving you even if your process should change tomorrow. You can change the tank mounting, shaft, impellers, to meet new mixing requirements. You can even interchange speeds—by replacing two easy-to-get-at gears.

Finally, you're protected *process-wise* when you choose LIGHTNIN Mixers. Every LIGHTNIN is unconditionally guaranteed to do the mixing job right.

Your LIGHTNIN Mixer representative can tell you more about the long-term savings you can make with LIGHTNINS. You do not obligate yourself in any way—so why not give him a call right now.

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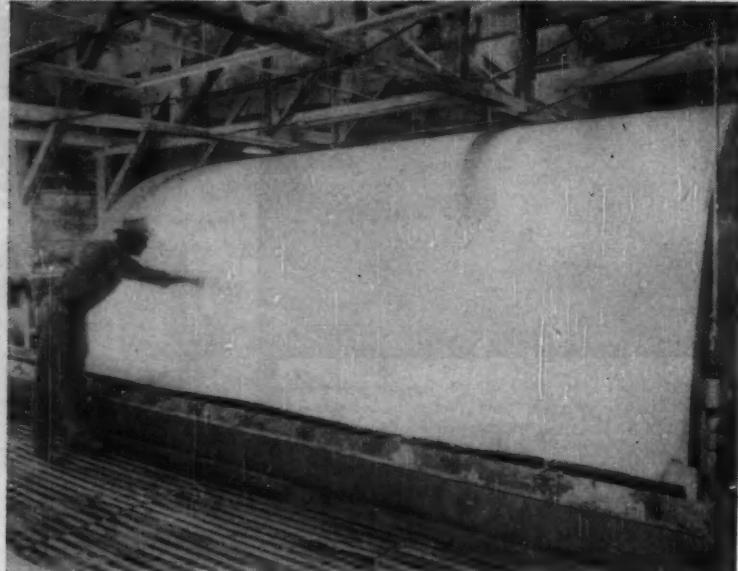
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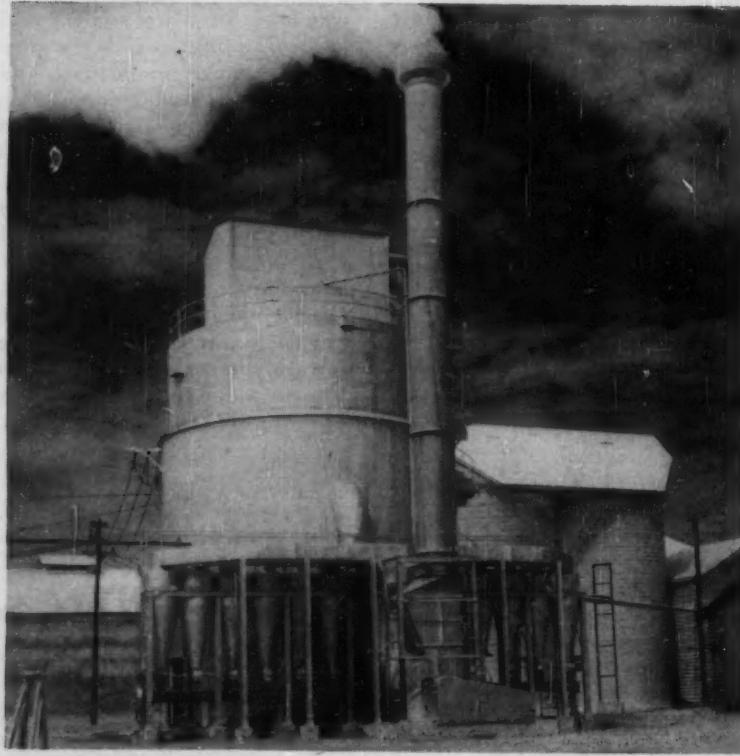
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

**WHAT'S HAPPENING . . .**

## Dispersant Cuts Cost of Spray Drying



To filter cake, add a dispersant: 60% slurry goes to a . . .



Spray dryer, where water is removed from the product.

HAVE you ever tried to spray-dry a slurry containing 60% solids? Minerals & Chemicals Corporation of America, at its McIntyre, Ga., plant does it on a production basis.

To overcome the cost disadvantages of spray drying, MCCA uses a dispersant—tetrasodium pyrophosphate—to turn a high-solids-content filter cake containing aluminum silicate pigment into a free-flowing slurry.\*

The result is an economical spray-drying process that has:

- A high production rate. Previously a 25-30% slurry was used. Now the feed slurry to the dryer has 60% solids. The increased solids throughput boosts production.

- A low fuel cost. Less water has to be removed.

- An improved product. Slurry viscosity is very low. This results in a fine spray, which produces a completely dry product, having high bulk density and good dispersion characteristics.

Spray drying is the only method which produces aluminum silicate pigment with a satisfactory particle size and shape. That's the reason other methods such as tray or rotary drying, which usually have lower operating costs, were not considered in the design.

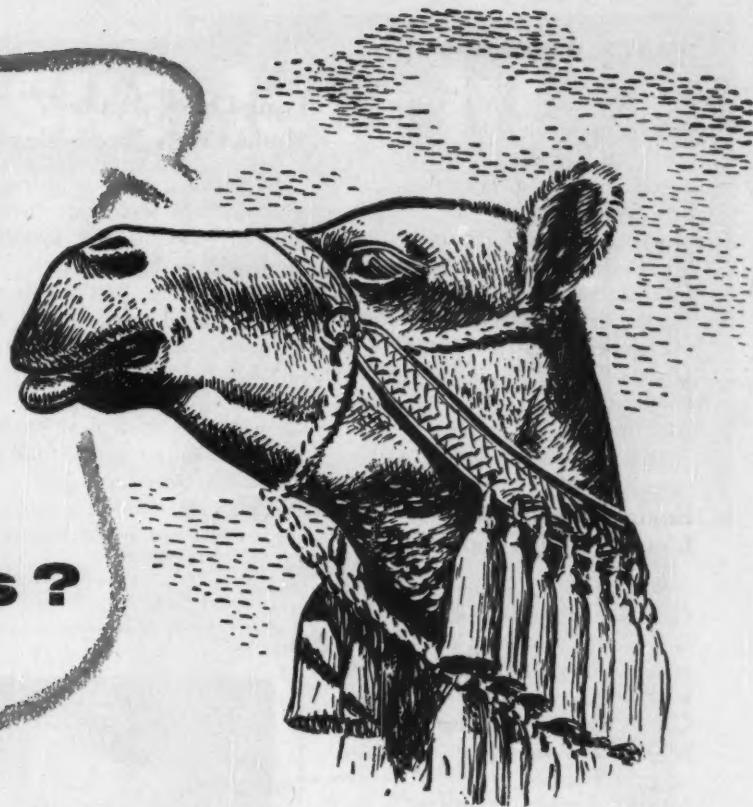
► **How the Process Works**—Mined kaolin is dumped into a mixing tank, where water is added to form a slurry. After thickening, degritting, classification, bleaching and dewatering operations, the slurry is fed to a rotary vacuum filter. A washed cake with a solids content of 58-60% comes off, and goes to a mixing vat.

Here the dispersant, tetrasodium pyrophosphate, is added (0.2% based on solids content). The cake now becomes a free-flowing slurry, which is passed through a screen and liquid magnetic filter.

It then enters the 29½-ft. dia.

\* Covered by Patent No. 2,540,182, the process is offered under license.

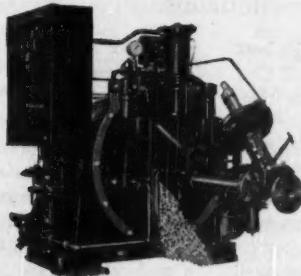
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That is only part of the story of the Sharples Super-D-Hydrator: this high speed dehydrating centrifuge provides precise external control of variations in flow rate, crystal size, and slurry concentration, and permits intermediate treatment of crystals as required.

Enjoy the advantages of the complete flexibility of the Super-D-Hydrator—which result in predictable crystal purity, dryness to specification, continuous high production, and trouble-free operation.



*You may count on the wide experience of The Sharples Corporation in the field of improved crystal dehydration. We will be pleased to discuss your specific problems personally, or Bulletin 1257 will be sent upon request.*



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## WHAT'S HAPPENING . . .

stainless spray dryer. Flowing through a nozzle, the slurry impinges on a rotating (10,000 rpm.) impeller. This gives a fine, umbrella-type spray. The droplets contact a countercurrent flow of heated air (1,000 F.) and take the form of small, free-flowing globules.

Exit air passes through a bank of cyclones which recover entrained clay particles. The final product is stored in silos, and from there goes to hopper or boxcars.

### Foam Vinyl Process Licensed by Goodrich

Seeking expanded markets for its Geon vinyl dispersion resins, B. F. Goodrich Chemical Co. has obtained a license to do development work with Elastomer Chemical Corp.'s continuous foam vinyl process. In addition, Goodrich says it's prepared to render service to other licensees on the application of Geon resins to this process.

In concept, the process is simple. Inert gas is dissolved under high pressure in a vinyl plastisol. The resulting foamed plastisol is then released through a spray nozzle into a mold or onto a casting surface and fused to form the finished product. Both continuous sheet and molded items can be made, including automobile and furniture cushioning, sound proofing and insulating material, mattresses and rug backing.

### No Storage Goals Needed for Nitrogen

Concurring with industry representatives and recommendations by the Business and Defense Services Administration, the office of Defense Mobilization has decided not to establish an expansion goal for nitrogen storage facilities.

The question was first discussed at an industry-BDSA meeting in October. At that time it was agreed that more storage facilities are necessary, but most industry spokesmen pointed out that these are already being built without accelerated amortization.

### Long-Chain Alcohols Made From Wool Wax

In Australia, catalytic hydrogenation of wool wax acids to commercially more useful long-chain alcohols is giving good yields on a laboratory basis. Best results have been obtained using copper chromite catalyst at about 4,000 psi. and 570 F.

Still another possible use seen for wool wax acids is as modifiers—with phthalic anhydride and glycerol—for alkyl resins.

This work with sheep wax is being carried out in Melbourne by

the Commonwealth Scientific and Industrial Research Organization. The group is also successfully hydrogenating wool wax itself.

Working even closer to the sheep's back, Commonwealth has developed a commercial flotation process for recovering wool wax from fleece. Its main feature is aeration of wool scour liquors in modified mineral flotation equipment. Froth is circulated through the flotation machine impellers to reduce bulk, water-washed, and dispersed in hot alkaline solution to give a concentrated emulsion. Wax is then centrifuged out.



### Heat recovery aids pelletizing

Boasting simplicity and high heat utilization, Arthur G. McKee & Co., Cleveland, and Allis-Chalmers Mfg. Co., Milwaukee, have come up with a new way to heat-harden pellets made from taconite iron ore. And they are optimistic about its usefulness for certain non-magnetic ores, too.

In order to get iron out of taconite, it's necessary to crush the ore very finely. But powder isn't good blast furnace charge, so pellets are made and heat-hardened to minimize breakage in transit. Most com-

panies use drum pelletizing and sinter in a vertical kiln.

McKee and Allis-Chalmers, however, have gone instead to a traveling grate sinter, normally less efficient heatwise. To overcome this disadvantage, pellets containing powdered coal are preheated, then ignited at about 2,400 F. This causes a molecular change in the concentrate which in turn generates heat of its own—up to 40% of the heat input. Retained heat in the burned pellets is recovered and used to preheat unsintered pellets in the feed.

# EPON<sup>®</sup> RESIN does it!

New paint  
lasts years  
...resists  
corrosive spillage  
at  
Diamond Alkali  
plant

## HERE'S HOW...

PAINT LEADS a hard life at the Diamond Alkali Company agricultural chemicals plant in Houston, Texas . . . and no ordinary paint can survive there for long!

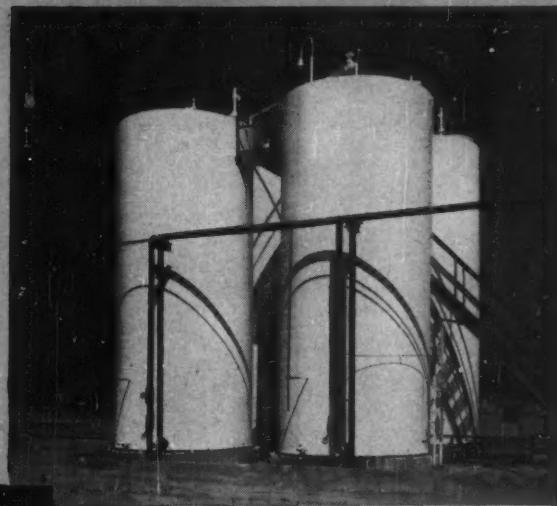
A few reasons for paint failure: Processing vessels and storage tanks are subjected to spillage of chlorinated hydrocarbons and benzene, and some also to heat. In parts of the plant, painted surfaces are exposed to the highly corrosive fumes of hydrogen chloride and sulfuric acid.

In their search to find a tougher, longer lasting paint, Diamond Alkali maintenance men tried coatings of many types, including heavy duty maintenance finishes. Some "washed

off" immediately; some lasted 6 to 8 months. Finally, Epon resin coatings based on the XA-200 formulation were tried — and found outstandingly successful.

The Epon cold-cured paint, applied by spraying throughout the entire plant, has been in service for more than two years with no failure. Painting costs — for both material and labor—are a mere fraction of what they formerly were, reports Diamond Alkali.

Call on our sales offices for names of suppliers who sell Epon resin coatings for your needs. Write for the full Epon coatings story in the new brochure, "Planning to Paint a Pyramid?"



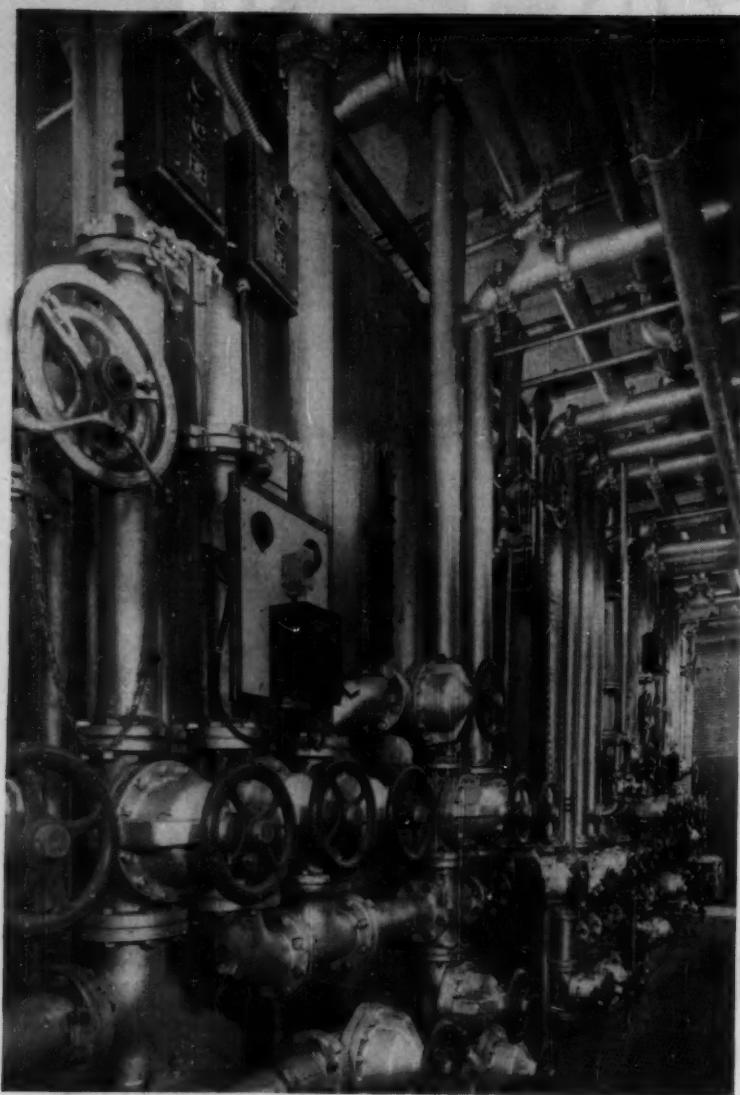
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**WHAT'S HAPPENING . . .**



RESIN TOWER row at Utah sugar refinery where . . .

## **Ion Exchange Sweetens Sugar**

**Layton Sugar uses it to purify both cane and beet sugar, claims lower costs, greater process flexibility, increased yields and higher purity.**

Ion exchange can replace sulfur bleaching in beet-sugar refining, can supplant bone-char decolorization in cane-sugar purification. So says Layton Sugar Co., Layton, Utah, which claims to be first in the world to use exchange resins

for full-scale purification of both beet and cane sugar.

Layton made the former substitution in 1946, the latter in 1952, now reports success for both. Although achieving that success took seven long years of development

work, this veteran sugar refiner thinks the uphill struggle was worth all it cost, cites these advantages for ion exchange over conventional purification methods:

- Lower costs: Ion exchange columns replace the conventional decolorizing unit for cane sugar, take up far less space than equivalent bone-char or activated-carbon operations. In beet-sugar refining they supplant the sulfur bleaching step. Decolorizing cost for IE is 2½¢ per 100-lb. bag of refined cane sugar; costs using bone char have run as high as 7¢ a bag. And ion exchange eliminates scale buildup in evaporators, saves Layton the 8,000 man-hr. a year previously spent in descaling.

- Greater process flexibility: Since ion exchange equipment handles both cane and beet sugar with equal facility, Layton can now switch more easily from beet to cane production. This is especially important to an inland refiner like Layton, confronted not only with seasonal fluctuations in beet supply but also with a steady decline in the cultivation of sugar beets because of competitive crops and industrial and residential demands for land.

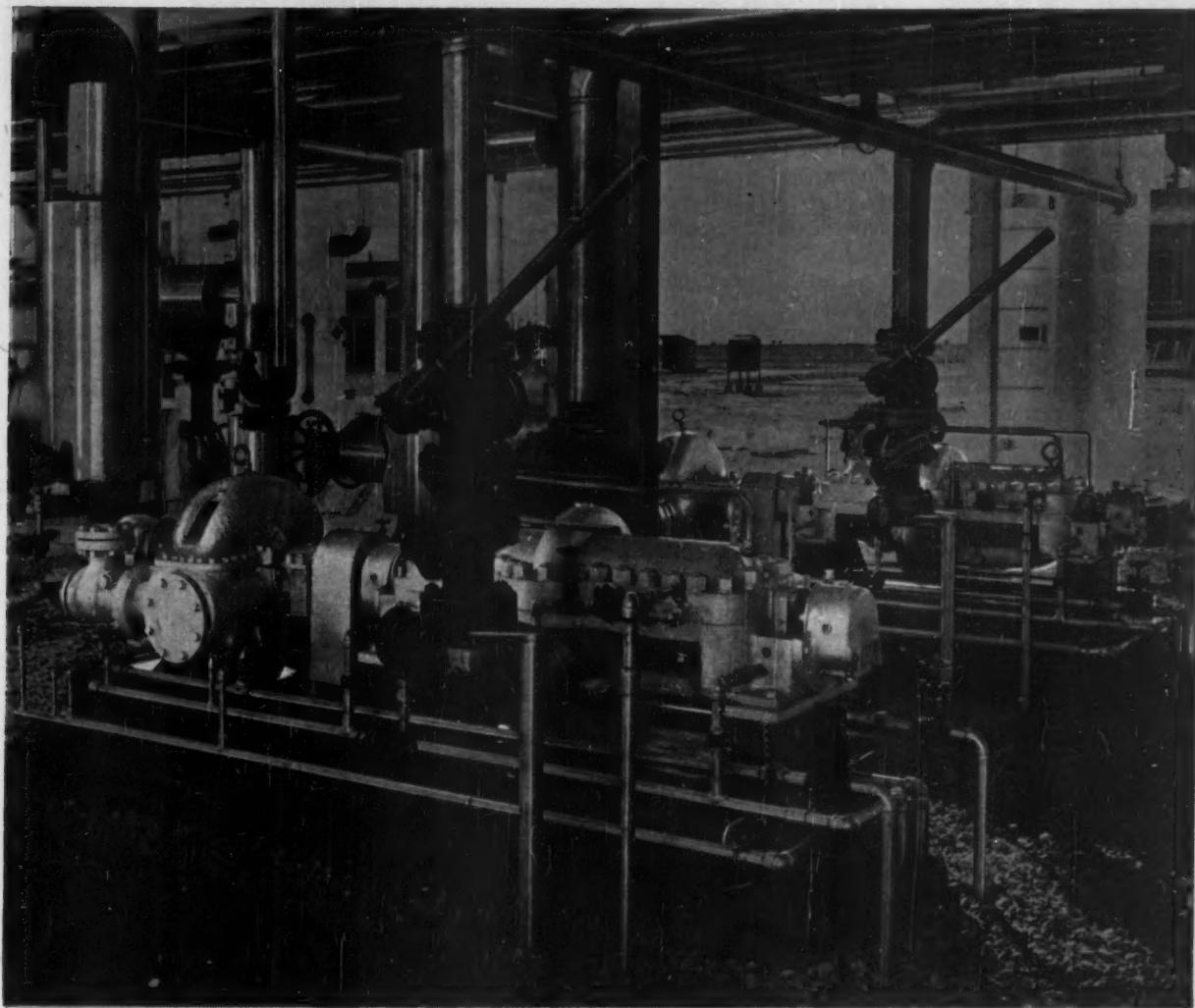
- Increased yields: More sugar—25-32 lb. more per ton of beets—when using ion exchange. Less molasses, too—only 1% of total raw beet weight vs. about 4% in the usual process.\*

- Higher purity: In the exchange process, sugar from the first crystallization stage (strike) contains 0.0005% ash, as against 0.010-0.015% for conventional refining. Furthermore, Layton claims liquor from the third strike has greater purity than usual first-strike liquor.

► **Process Bugs**—In 1946 Layton, working with Illinois Water Treatment Co., Rockford, Ill., and Chemical Process Co., Redwood City, Calif., first pilot-planted its ion-exchange process. In 1947, despite some problems which were still unsolved, Layton adopted the

\* This would be undesirable when molasses is selling at a high price. Harold E. Ellison, Layton's production manager, puts the break-even point at about \$45 a ton, all factors considered. Present molasses price—less than \$30.

# on deethanizer feed at PEGASUS PLANT



**Ingersoll-Rand Pumps** are giving efficient and dependable service at the Pegasus Plant in West Texas, operated by Magnolia Petroleum Company and built by Hudson Engineering Corporation. The two 2CNTA 8-stage steam-turbine-driven units shown above are on deethanizer feed service, handling 202 gpm of unstabilized gasoline of 0.515 specific gravity at 90°F. Suction pressure is 90 lbs. and developed head, 2155 ft. at 3500 rpm. Multi-stage Class CNTA pumps, with easily removable unit-type rotor assembly, are exceptionally well suited to refinery service involving pressures from 100 to 800 lb. and capacities from 50 to 700 gpm.

Other Ingersoll-Rand centrifugal pumps in continuous operation at the Pegasus Plant include many different units in a wide range of types, sizes and applications.

Consult with the I-R branch office near you for the solution of all your liquid moving problems.



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## WHAT'S HAPPENING . . .

technique for commercial beet-sugar purification and has been using it ever since (see *Chem. Eng.*, July 1948, p. 114, for description of original installation).

Actually it has taken from 1946 until now to iron out all the process kinks. During that period Layton made three important discoveries:

1. Raw beet juice can't be sent through the ion-exchange column as it comes from the diffusers (juice extractors); there is too much foam, too much colloidal and organic material for the resin capacity of a practical unit. Conventional processing must, then, precede ion-exchange purification of beet sugar.

2. Off-color fractions can't be upgraded by recycling through the exchange column; impurities that get through the first pass have to be eliminated by recrystallization.

3. At the lower temperatures involved, biological contamination of the juices is a very real problem.

► **Beet-Sugar Process**—Raw sugar extract from the diffusers is heated to 87 C. and sent to a carbonator, where CO<sub>2</sub> and milk of lime (2% CaO) precipitate colloidal impurities. At a pH of 8.5 the slurry is clarified and the filtrate passed to a second carbonator. There another pH adjustment precipitates residual lime, which is filtered off.

Lime-carbonate treatment replaces the usual lime-phosphoric combination for flocculation and clarification because it produces a higher pH, greater color stability in the finished product, and increases the efficiency of ion exchange and subsequent over-all sugar extraction.

In conventional refining the filtered juice from the second carbonator goes to a tower, where sulfur fumes bleach the organics, knocking the pH down to about 8.0. Bleach-tower solution is then evaporated from 14% to 67% solids, filtered, cooled and the sugar crystallized.

► **With This Difference**—Layton, however, cools the second carbonator filtrate from 85 C. to 17.5 C. and puts it through a cation ex-

changer where, at a pH of 1.5-2.5, nonsugar salts are converted to acids. A pass through an anion exchanger adsorbs these acids, plus color bodies.

About 95% of the total inorganic impurities and 65% of the organic impurities are removed in the exchange process. Resultant liquor is water-white, 99.0-99.5% pure, contains no sulfites and only 1-3 ppm. CaO. Six strikes (as against three in usual refining) are taken in the evaporators; three are marketable as such, three require recrystallization.

Although at lower pH there is a greater tendency to form invert sugar, in actual practice Layton's low exchange temperature—plus the short retention times normally used in resin columns—keeps the invert concentration down to 0.14% on a dry basis.

► **Now Comes Cane**—Layton originally put in ion exchange for beet-sugar refining. But as sugar-beet land in cultivation in that region switched to other uses, Layton turned to Philippine cane sugar to supplement its raw material supply and maintain a level production rate. By the end of the 1952 beet campaign the company had perfected use of ion exchange in cane-sugar processing, now has a daily melt capacity of 400 tons.

In cane-sugar production, ion exchange replaces bone-char or activated-carbon decolorizing towers, takes up far less space. (Half the space in a conventional sugar refinery is taken up by the bone-char unit, with its regeneration and storage areas.) Production Manager Ellison estimates capital costs for ion-exchange installations in general would be just about one-tenth that for comparable bone-char operations, exclusive of initial bone char costs.\*

► **Exchange Equipment**—Layton's four cation columns are straight-side tanks 10 ft. in diameter by 13½ ft. each containing 625 cu. ft. of Dow MX resin. The four anion columns are 10 ft. in diameter by

11 ft., hold 412 cu. ft. each of Chemical Process A-2 resin. Exchange cycle time is 2 hr., with a 4-hr. resin regeneration period.

In more than six years of operation with beet and cane sugar Layton has added only 5% makeup resin, still has about 90% of its original effective capacity. Resin regeneration requires 2.4 lb. of caustic soda (100% NaOH), 15 lb. of sulfuric acid and 6.5 lb. of ammonia per ton of beets processed.

► **Freight Rate Picture**—There's another interesting—and telltale—facet to the economy of sugar refining—freight costs (still one of the biggest factors in sugar's total cost).

During big beet-sugar years, cane sugar refining and consumption decline (and vice versa). By refining both cane and beet sugar a refiner can realize better operating balance, whether beets are overabundant or whether they are losing ground to other interests.

More favorable freight rates for movement of both raw materials and finished sugar would permit inland beet refiners like Layton to figure closely the optimum balance between beet and cane. Ion exchange can then help many of them obtain this balance.

And ability to establish new plants in the best location with regard to markets and raw materials—to get the best possible break on freight costs—would make a big difference to many processors.

► **Others, Too**—Layton is certainly not the first, nor is it at present the only domestic sugar producer working on ion-exchange purification. Hawaiian Pineapple uses ion exchange to recover sugar from pineapple waste for its own use. American Molasses, Louisiana Liquid Sugars, and Refined Sugars and Syrups also use ion exchange—but not to the extent Layton does.

The Dorr Co. in 1940, working with Amalgamated Sugar Co. at Burley, Idaho, designed and built a pilot plant using ion-exchange resins. Outcome was the Twin Falls, Idaho, plant, with a capacity of 2,200 tons of beets a day; it operated this way in 1946-47 but is not now using ion exchange.

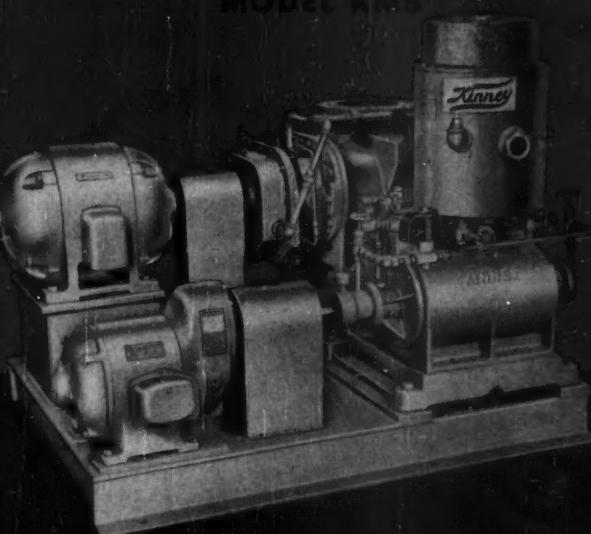
\* California & Hawaiian Sugar Refining Corp.'s 3,500-ton-a-day plant at Crockett, Calif.—largest sugar refinery in the country—has an average inventory of 5,000 tons of bone char.

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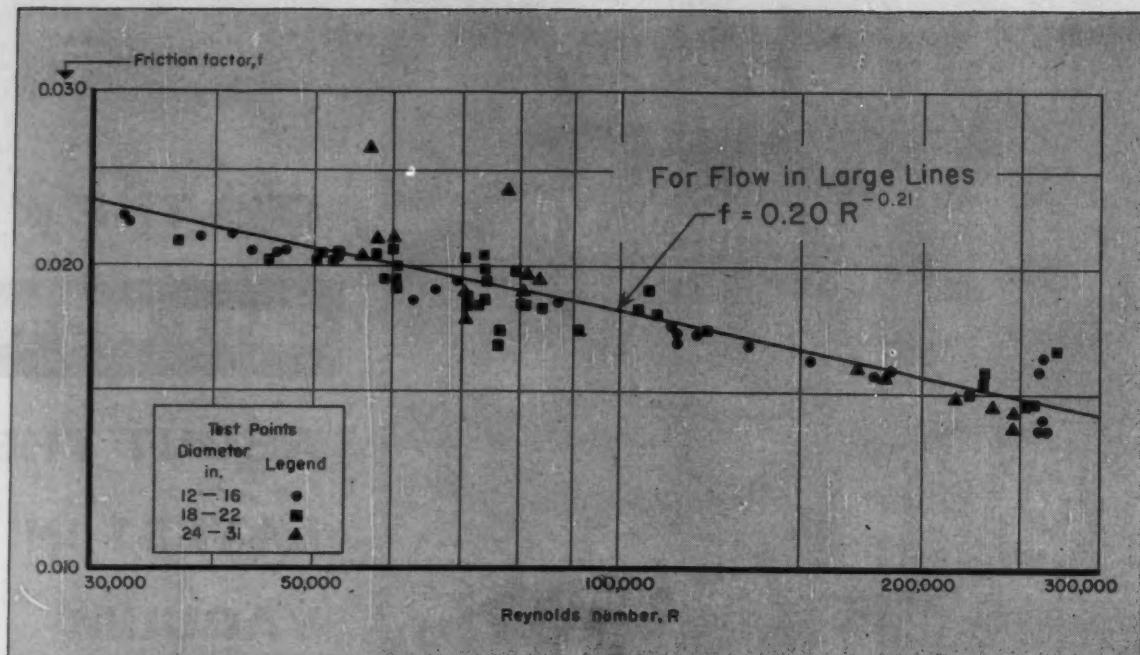
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**WHAT'S HAPPENING . . .**



## Predicted Pressure Drop Proved in Field

**Tests from 15 companies, operating large-diameter pipelines in 12 states, coincide with Stanton-Pannell data. Actual confirms theoretical—40 years after.**

Chemical engineers have been able to predict the relationship between flow rate and pressure loss in small diameter pipelines. They've been doing it successfully for many years. But data to indicate a relation between actual and theoretical flow in large-diameter lines have been lacking—primarily because it's impractical to test long sections of large lines in a laboratory.

Now, actual tests have been made on long pipelines up to 31-in. diameter at Reynolds numbers from 30,000 to 250,000. During the past two years, 15 companies that operate long lines submitted test results to the American Pe-

troleum Institute's Subcommittee on Pipeline Hydraulics.\* The conclusions:

- Predictions published by Stanton and Pannell in 1914 for the higher Reynolds number range have been corroborated in larger diameter pipelines now in crude-oil service. Designs based on these data—particularly for 6-in. diameter and larger—should be sound and reliable.

- It's believed that petroleum products lines, 6-in. and larger, operating at much higher Reynolds numbers, will further substantiate the Stanton-Pannell data, provided pipe smoothness has been maintained. This same basis of design should be reliable for new products lines.

► **40 Years to Prove**—Stanton and Pannell studied the flow of air and

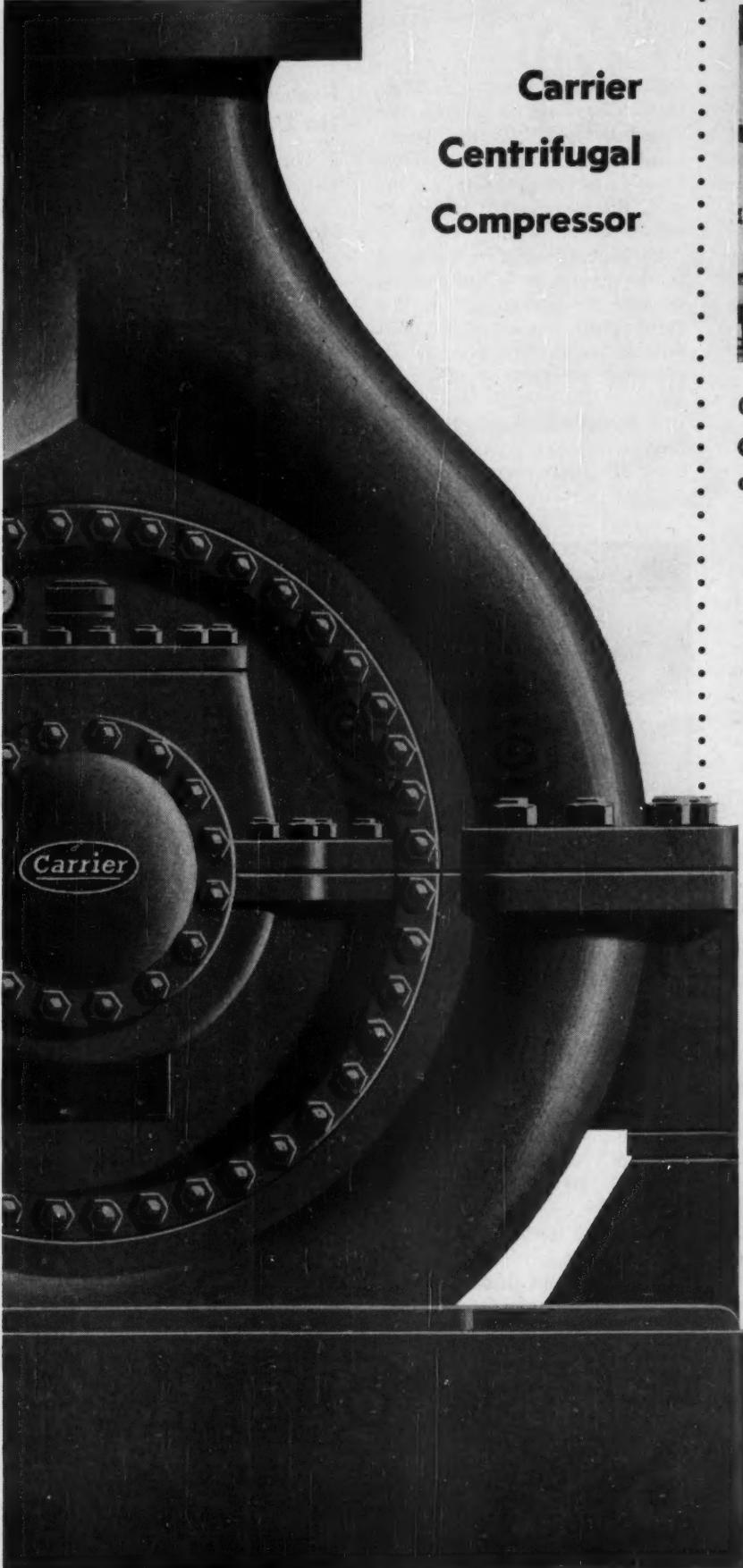
water at varying rates through smooth brass tubes of different diameters. Their work has been confirmed by later experiments on other fluids. Results of tests made on crude-oil lines in the 1920's for 6-in. to 12-in. pipe coincided very well.

Further confirmation in larger pipes didn't come until the end of 1954. Results are reported on tests in clean-scraped lines—diameters: 12, 16, 18, 20, 22, 24, 26 and 31 in.; lengths: 7 to 176 miles; differential pressures: 11 to 1,122 psi.

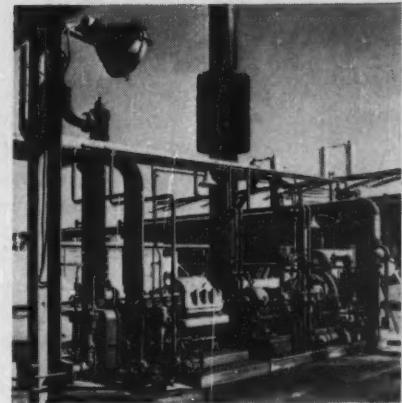
The original Stanton-Pannell correlation showed a slight curvature but it can be represented by an approximate straight line. From these latest tests a Reynolds number-friction factor equation is established. Although the range is limited, it's reassuring to know that the theory works in practice.

► **Abundance of Formulas**—Unlike the case of streamline flow, there isn't a straight-line relationship between friction factor and Reynolds

\* For data and detailed conclusions see "Pressure Loss in Oil Pipe Lines" presented by W. L. Kennedy, Jr., at the API Annual Meeting, Chicago, Nov. 9, 1954.



## Carrier Centrifugal Compressor



on the job at  
**Celanese Corporation  
of America**

This Carrier Centrifugal Compressor is on the job in the Celanese plant at Bishop, Texas. It compresses air from 84 to 130 psig. The unit is driven at 9030 rpm by an expansion turbine using effluent nitrogen. A total of 16 Carrier Centrifugal Refrigerating Machines are used at other Celanese plants in Charlotte, N. C., Celriver, S. C., and Celco, Va.

Carrier makes a complete line of centrifugals for gas compression and refrigeration—up to 10,000 hp in a single unit. There are hundreds of these dependable, efficient Carrier machines on the job at dozens of chemical plants and refineries across the country—Reichhold Chemicals Company, Cities Service Company, The Texas Company. May we assist you? If you'd like a copy of our informative booklet,

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for Industry,"**

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centrifugal compressors  
refrigerating equipment

## WHAT'S HAPPENING . . .

number in the turbulent-flow region. Many approximation formulas have developed since 1914. The lack of agreement is that developers select different points and different ranges on the friction-factor curves.

Also, from the data obtained in these latest tests, it can't be said that there is a correlation between friction factor (or pressure drop per mile) and the size of line.

### New Polyvinyl Acetate Emulsion Plant Rising

Just about to go on stream is the Borden Co.'s new polymerization unit at Dominguez, Calif. It's slated to turn out 3 million lb. a year of polyvinyl acetate emulsions and will be Borden's fifth emulsion polymer plant.

Sharp increase in demand for emulsion polymer paints is the reason for the expansion. According to Augustine Marusi, president of Borden's Chemical Div., these paints already account for half of all interior paint sales. He also points out that the polyvinyl acetate emulsions are rapidly encroaching on the markets held by butadiene-styrene latices, which were first in the interior paint field, and may even replace them in the near future.

### Diamond Takes Over Army Chlorine Plant

Built during the Korean War to prepare for a chlorine shortage that never developed, the U. S. Army's \$21 million chlorine-caustic plant at Muscle Shoals, Ala., has been sold to Diamond Alkali Co. of Cleveland. Purchase price was slightly over \$15 million and Diamond expects to be in production early this month.

The plant, which had only one 30-day trial run after its completion in July 1952, has a daily capacity of 225 tons of chlorine and 252 tons of caustic soda.

In October 1953 it was declared surplus and offered for lease to private industry on a bid basis—

without success. Later, when Monsanto Chemical Co., which designed the plant for the Army's Corps of Engineers, did not exercise its 60-day option to buy the unit, the government decided to sell outright.

Early negotiations were stymied by the government's insistence on retaining the right to pre-empt the entire plant production to meet possible mobilization needs at its adjoining phosphate development works. This stand was subsequently modified and Diamond now says it's in a position to guarantee all supply commitments.



### England Gets First Silicone Production

A \$3.2 million plant with an annual capacity of nearly 700 tons of silicones has been opened by Albright & Wilson at Barry, England. It is the first commercial silicone plant in the country and when full production is reached—probably before spring—it will be able to meet 95% of Britain's demand.

Basically, the plant catalytically converts silicon and methyl chloride to chlorosilanes and finally into the various silicones. These products—rubber, insulating compounds, paints, greases, laminates, fluids and water repellents—will be marketed in England by Midland Silicones, Ltd., a joint subsidiary of Dow Corning Corp. and Albright & Wilson.

### High Court Will Review Du Pont Cellophane

The Supreme Court has decided to hear arguments and then decide on whether Du Pont has monopolized the cellophane industry.

This case began in 1947. The last previous decision came over a year ago from the U. S. District Court in Delaware which dismissed the government's suit for insufficient evidence. The court held that Du Pont's cellophane dominance resulted from "technical skill and competitive activity," not "predatory assertion of monopoly power."

### Lineup Changes Made In Atom Power Study

A request by Dow Chemical Co. to withdraw from the industrial atomic power development project begun by Dow and Detroit Edison in 1951 spotlights the fact that the immediate aim in private nuclear research is the actual design and construction of an economical commercial power reactor.

Dow's decision to leave the project is based on the company's primary interest in the chemical aspects of atomic power and the possible utilization of nuclear reactor byproducts in the chemical industry. Said Dow's president, Leland Doan, "from this point on it is not logical for us to continue participating in a program directed at the development of atomic power as such."

But though Dow is out of the power side of nuclear energy, other firms in or closely allied to the chemical process industries are still very much interested. Most recent evidence is the formation of a nine-company Rocky Mountain Nuclear Power Study Group—the 16th currently authorized under AEC's industrial participation program. Included among the participants are Phillips Petroleum, Minnesota Mining and Manufacturing and Fluor Corp. Stated purpose is to study at their own expense nuclear power possibilities in the western United States.



## **petrochemical processes**

phenol  
methanol  
maleic and phthalic anhydride  
ethylene oxide glycol ethanolamines  
ammonia nitric acid ammonium nitrate urea



Foster Wheeler has been actively associated with both the petroleum and chemical industries for over 30 years and has designed and constructed many individual petrochemical process units as well as complete chemical plants.

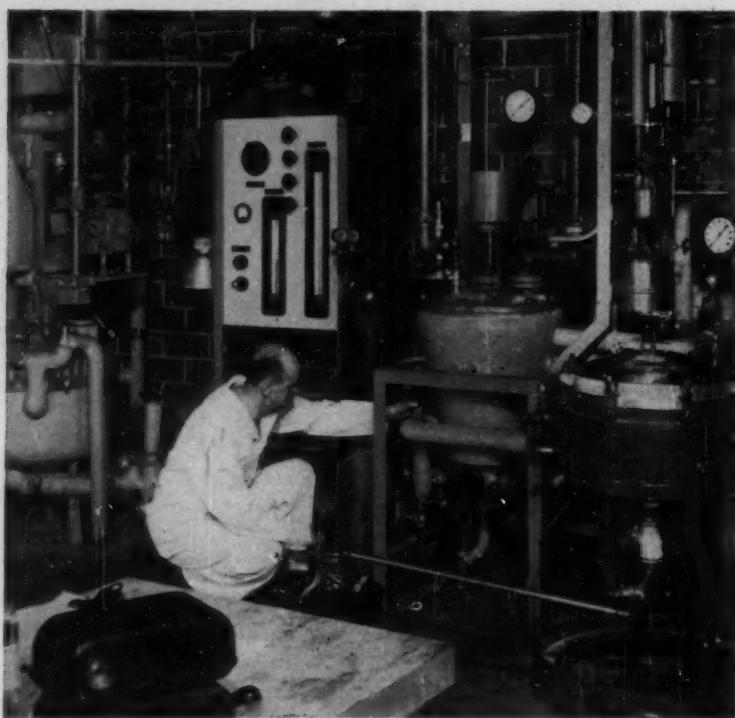
### **FOSTER WHEELER CORPORATION**

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**NOW UNDER CONSTRUCTION:**

- 5 complete ammonia producing plants
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## WHAT'S HAPPENING . . .



$$R \leq (YSN - P - W)/r$$

**With this formula you can estimate the maximum amount of money which you can afford to spend on new product research and development.**

Although no executive in the chemical process industries today ever questions the value of research, many are faced frequently with the question of how much money to spend on research and development.

Shown above is a formula designed to answer, at least in part, this question. Dr. Ralph H. Manley, managing director of General Mills' research laboratories at Minneapolis, Minn., introduced it recently at a conference of research administrators.\*

This formula applies specifically to that phase of research effort devoted to new product development. It can't be used to budget funda-

mental research or improvement of existing products to maintain competitive position.

► **How It's Derived**—According to Dr. Manley, the ultimate profits from new products developed through research must carry (a) the new product research and development costs plus (b) the cost of the new facilities required, and (c) must recover working capital required to finance the new operation.

On the debit side, then, is plant investment  $P$ , working capital  $W$  and research and development cost  $Rr$ . (In this latter term,  $R$  is research and development cost before taxes and  $r$  is the fraction of research and development cost which is not tax-deductible.) The sum

of these three terms, divided by the recoupment period  $Y$ , should be less than or equal to the annual profit, which can be expressed as annual net sales volume  $S$  times minimum acceptable net profit after taxes  $N$  (as percent on sales).

Setting this up as an equation,

$$\frac{P + W + Rr}{Y} \leq SN$$

or

$$R \leq (YSN - P - W)/r$$

► **For Example**—Manley assumed for illustration purposes that a \$1-million plant would produce \$10 million worth of goods per year and that it would take \$1 million of working capital to run this plant. The new business should pay for itself in six years.

Minimum return assumed was 4% on sales after taxes, and 50% of research expense was tax-deductible.

Solving the formula for  $R$ , Manley gets a figure of \$800,000. This, then, is a guide to the maximum amount the company could afford to spend on research and development in order to get into the new business.

► **Real-Life Decisions**—Such a formula is far from perfect, admits Dr. Manley. For one thing, it makes no allowance for projects that fail. Nor does it answer questions like these:

- Would production and distribution of the new product integrate with existing company operations?

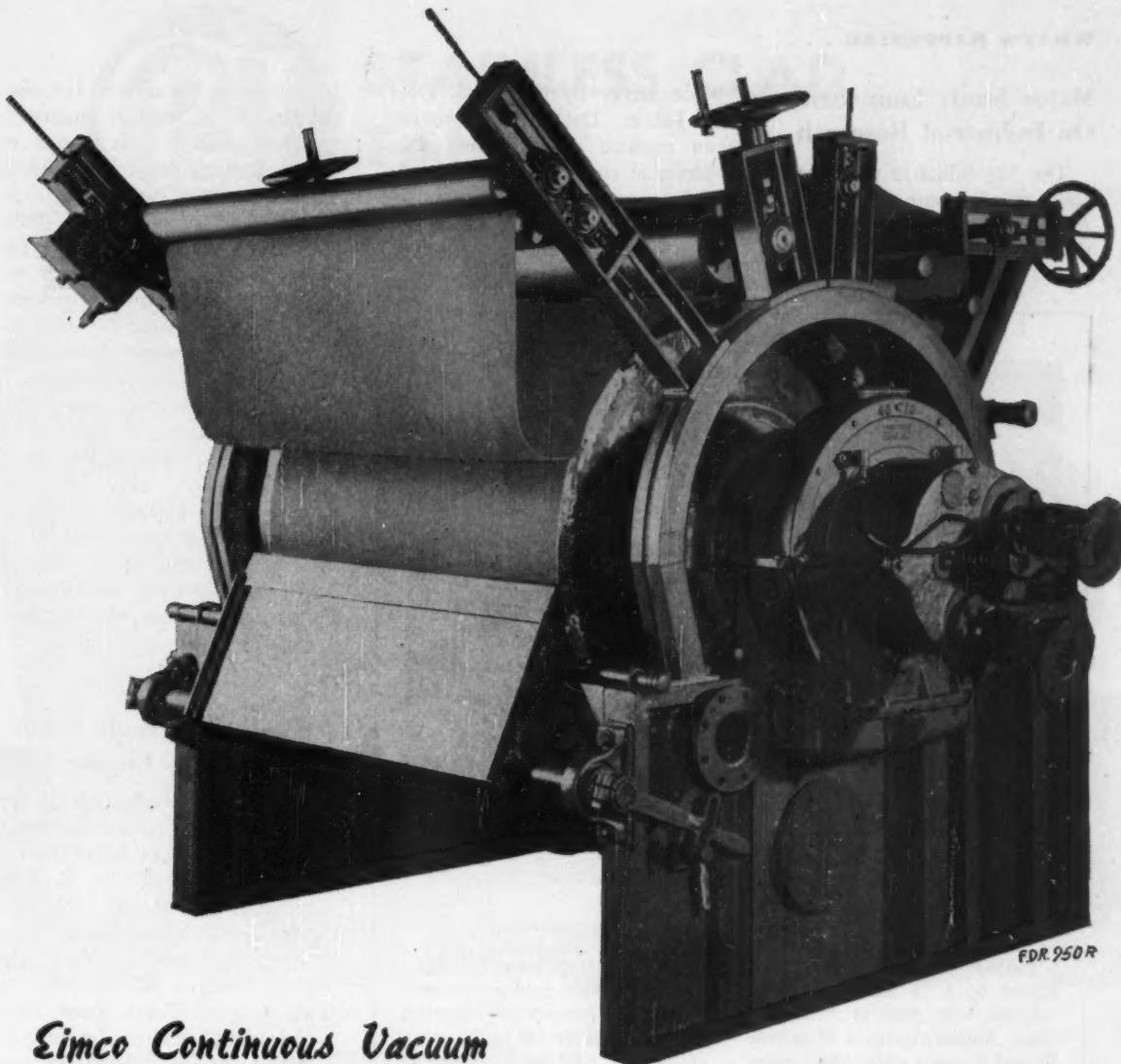
- Can the new product be placed on the market without adverse effect on existing company business?

- Do market research data assure that an adequate market exists or can be developed?

- Are there any issued patents which would prohibit production or sales?

But if the answers to these and other such searching questions are all favorable, says Manley, and if research management thinks that the research team can develop the new product within the cost range suggested by the formula, then there's adequate basis for going ahead with the project.

\*Fifth Annual Conference on Industrial Research, Columbia University, New York, June 8, 1954.



## *Eimco Continuous Vacuum Filters Using Compression Blankets*

Another example of the many types of Eimco Continuous Vacuum and Pressure Filters. Filters of this type have been in use in many plants and provide many advantages where the material to be filtered produces a flocculent solid type cake.

Eimco filters of the type shown above, introduce a wash spray to the cake formation immediately after it emerges from the liquid in the tank and the compression blanket binds the cake to drum within a few inches of the slurry level. The blanket covers the cake to the blow zone above the scraper blade.

This type Eimco filter prevents cake cracking, greatly improves washing and on some types of filter cake, will reduce moisture content in the cake by 8-10%.

Write for more information.

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## WHAT'S HAPPENING . . .

### Major Study Launched On Industrial Research

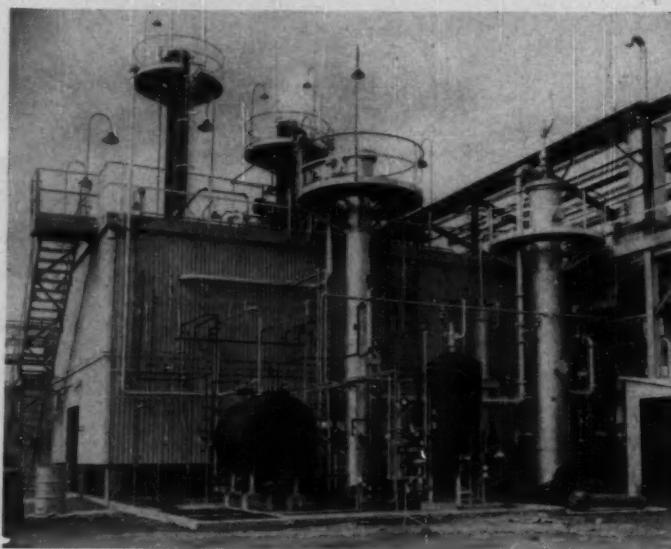
The \$2½ billion a year research and development program of American industry is going to be the subject of an intensive, nation-

wide survey by the U. S. Dept. of Labor. Data will be provided on research spending and manpower in every major industry.

Information is being sought not only on the cost in dollars and manpower of research performed

by companies themselves, but also on the cost of research purchased by industry from such sources as universities and research institutes. In addition, the National Science Foundation, for whom the study is being made, will conduct co-ordinated surveys on research activities of government agencies, colleges and universities, trade associations, commercial laboratories and nonprofit research institutes.

Most of the survey is being conducted on a questionnaire sampling basis to reduce costs. But interviews with about 200 large companies are also planned to bring to light any bottle-necks faced by industry in developing its research activities. Naturally, published information will not identify individual firms.



### New PVC plant uses suspension process

General Tire & Rubber Co. has started up a \$6 million polyvinyl chloride resin plant at Ashtabula, Ohio. Annual capacity is 25 million lb. and it uses a suspension process rather than the conventional emulsion technique.

From acetylene and hydrogen chloride, vinyl chloride monomer is made in the unit shown above. Monomer is then mixed with a sus-

pending agent—polyvinyl alcohol-catalyst and water, and polymerized. When the polymer is recovered, most additives are left in the water, giving very pure resin. According to Scientific Design, which designed the plant, the more widely used emulsion process leaves the processing chemicals in the final product, making it undesirable for some uses.

### Nucleic Acid Made From Spent Sulfite Liquor

Commercial production of nucleic acid from a plentiful and economic source—spent sulfite liquor—has been achieved by Schwarz Laboratories, Mount Vernon, N. Y., and the Rhinelander Paper Co. of Rhinelander, Wis. The liquor, which is rich in sugar, is used to grow Torula yeast, from which nucleic acid can be made.

Nucleic acids, which are very high molecular weight (one million) derivatives of nucleoproteins, are essential for the growth and proper function of living cells. Consequently this new, practically unlimited source will be important to studies of growth and aging.

### Volume 62—Chemical Engineering—Number 1

*Chemical Engineering*, with which is incorporated *Chemical & Metallurgical Engineering*, is the successor to *Metalurgical & Chemical Engineering*, which in turn was a consolidation of *Electrochemical & Metallurgical Industry* and *Iron & Steel Magazine*.

The magazine was originally founded as *Electrochemical Industry*, in September 1902, and was published monthly under the editorial direction of Dr. E. F. Roeber. It continued under that title until January 1905 when it was changed to *Electrochemical & Metallurgical Industry*. In July 1906 the consolidation was made with *Iron & Steel Magazine* which had been founded eight years previously by Dr. Albert Sauveur. In January 1910 the title was changed to *Metallurgical &*

*Chemical Engineering*, and semi-monthly publication was begun Sept. 1, 1915. On July 1, 1918, the title was changed to *Chemical & Metallurgical Engineering* and weekly publication was begun Oct. 1, 1919. Monthly publication was resumed in March 1925.

In August 1946 the words “*& Metallurgical*” were dropped from the main title to bring its name more in keeping with the editorial content.

Dr. E. F. Roeber was editor of the paper from the time it was founded until his death Oct. 17, 1917. After a brief interim he was succeeded by H. C. Parmelee. Ten years later, Nov. 1, 1928, Dr. Parmelee assumed other responsibilities in the McGraw-Hill Publishing Company and Sidney D. Kirkpatrick was appointed editor.

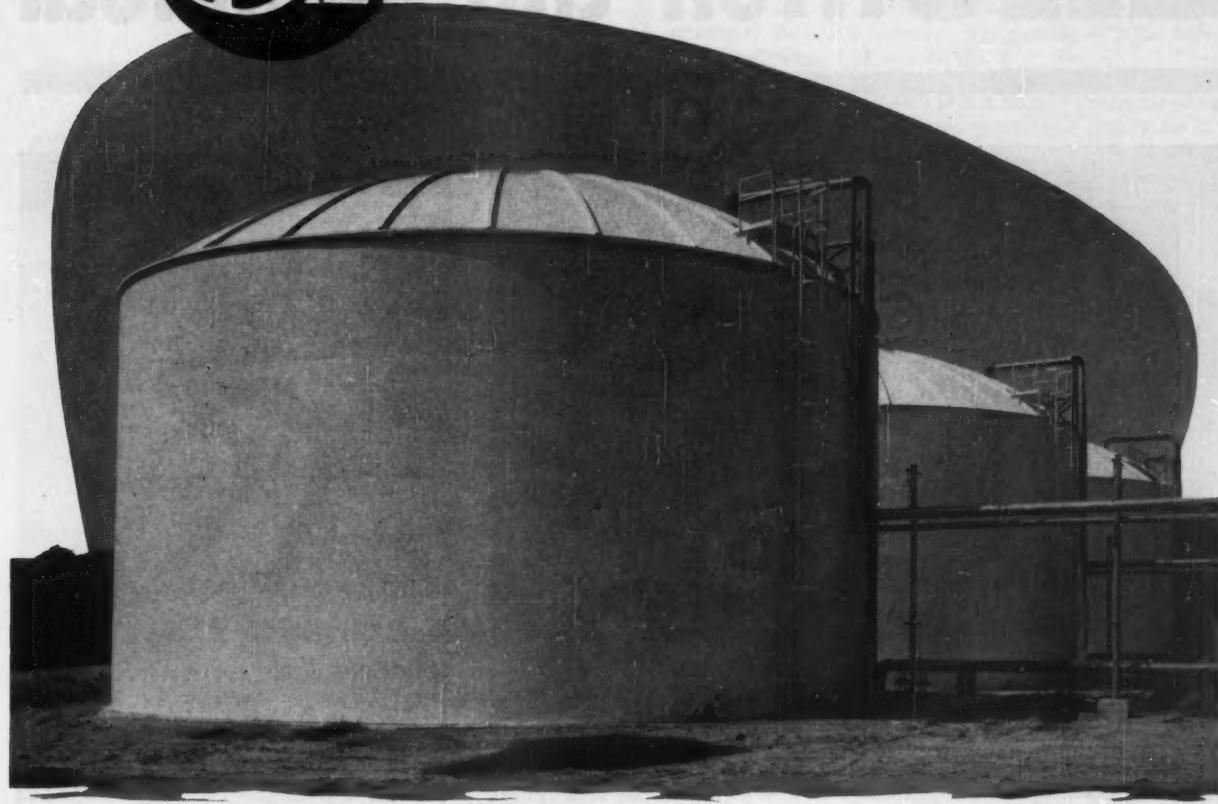
Dr. Kirkpatrick was named editorial director July 1, 1949, and at that time he was succeeded as editor by John R. Callahan.

The present editorial staff is, in addition to Dr. Kirkpatrick and Mr. Callahan: L. B. Pope, managing editor; T. R. Olive, senior associate editor; C. H. Chilton and M. M. Hoover, associate editors; C. S. Cronan, R. F. Fremed, R. B. Norden, H. T. Sharp, E. T. Thompson and Margaret Redfield, assistant editors; R. K. Gitlin, editorial assistant.

Editorial regional representatives are: J. A. Lee, Houston; Elliot Schrier, San Francisco; F. C. Byrnes, Chicago. [All rights to above magazine titles reserved by McGraw-Hill Publishing Co., 330 West 42 St., New York 36, N. Y.]



## STAINLESS CLAD TANKS



### store 83 per cent solution of ammonium nitrate

The Horton® stainless clad tanks shown above were installed to store an 83 per cent solution of ammonium nitrate at the Lion Oil Company's chemical plant at El Dorado, Arkansas. The ammonium nitrate is converted at the rate of about 400 tons per day into dry pelleted fertilizer, one of five nitrogen products produced at the plant.

Horton stainless clad tanks, like those at Lion Oil, are widely used for storage wherever corrosion is a problem. CB&I has complete facilities to engineer, fabricate and erect tanks of carbon steel, stainless steel or stainless steel clad or lined. Write our nearest office for estimates or quotations.

## CHICAGO BRIDGE & IRON COMPANY

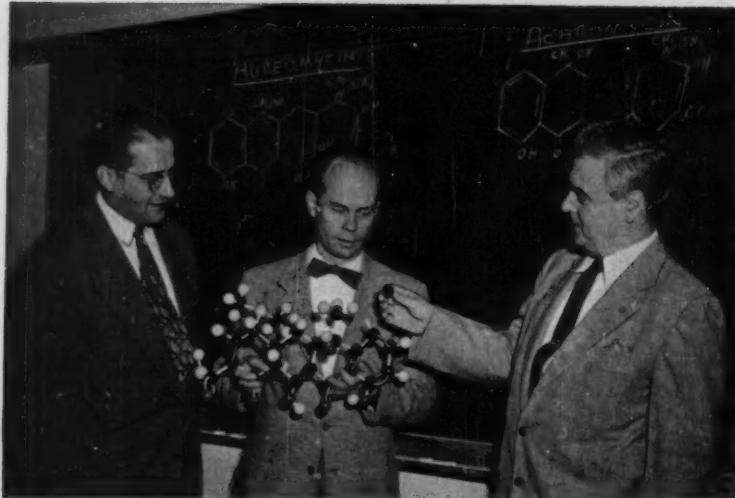
Atlanta 3.....2120 Healey Bldg.  
Birmingham 1.....1310 North Fifth St.  
Boston 10.....1005-201 Devonshire St.  
Chicago 4.....2124 McCormick Bldg.  
Cleveland 15.....2220 Midland Bldg.

Detroit 26.....1503 Lafayette Bldg.  
Houston 2.....2103 C & I Life Bldg.  
Los Angeles 17.....1505 General Petroleum Bldg.  
New York 6.....3318-165 Broadway Bldg.  
Philadelphia 3.....1625-1700 Walnut St. Bldg.

Pittsburgh 19.....3205 Alcoa Bldg.  
Salt Lake City 4.....505 West 17th South St.  
San Francisco 4.....1522-200 Bush St.  
Seattle 1.....1305 Henry Bldg.  
Tulsa 3.....1623 Hunt Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA

# Life...on the Chemical



**ACHROMYCIN FROM AUREOMYCIN**—It looks simple here, but removing one chlorine atom from the Aureomycin® chlortetracycline molecule to produce Achromycin tetracycline took years of research by many scientists at Lederle Laboratories. Dr. James Boothe, one of the chemists who worked on the problem, holds a three-dimensional atomic model of Aureomycin as Dr. J. H. Williams (right), Director of Chemical and Biological Research, removes the chlorine atom symbol. Dr. Nestor Bohonos, who heads Mycological Research, looks on. Achromycin is produced from Aureomycin by catalytic reduction at Cyanamid's Lederle Laboratories Division.

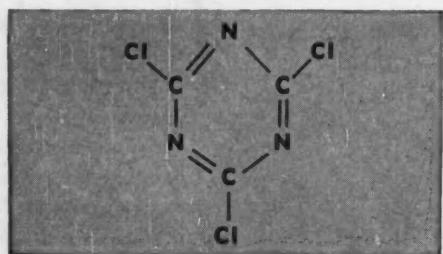
\*Trade-mark



**SLALOMING** at 70 mph and over demands superb skill, super qualities in skis. Top ski performance over dips and bumps, with low friction and no tip and tail flutter, are obtained with new plastic skis molded of Cyanamid's LAMINAC® polyester resin and glass fiber. High strength and extreme durability are combined with light weight and molded-in color to produce skis that never warp or need refinishing. (No. 2)



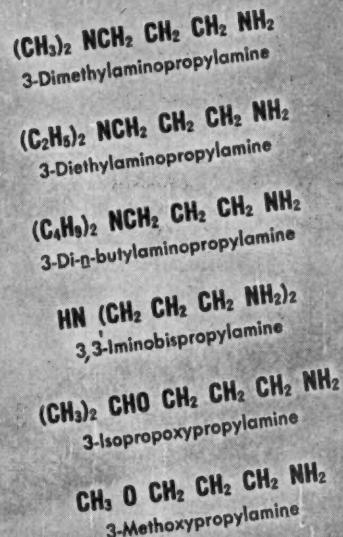
**U. S. POPULATION** is expected to pass 164,000,000 this month. This Department of Commerce "clock" records population growth minute by minute. Every 12 seconds there is one more mouth to feed! But there is no Malthusian dilemma—food abounds, thanks to good farm practice, development of new strains of plants and animals, and chemical aids for farmers. Cyanamid, long a major supplier of chemical aids to farmers, now produces anhydrous ammonia for direct application to soil, thus providing essential nitrogen at lowest cost per unit. Anhydrous ammonia is used also in mixed fertilizers. (No. 1)



**CYANURIC CHLORIDE** with its stable triazine ring structure and highly reactive chlorine atom on each carbon, offers interesting opportunities for organic synthesis. For example, the chlorines may be replaced with allyl groups to make triallylcyanurate—the basis for new plastics which retain much of their strength at temperatures as high as 500° F. Other cyanuric chloride derivatives are used as therapeutics and as bactericides. Still others produce brilliant dyes, and brighteners for detergents and textiles. When converted to cyanuric triazide, a brisant explosive is formed. It offers many other possibilities for further synthesis. (No. 3)

# Newsfront

**AMINES FOR NEW PRODUCT DEVELOPMENT** listed below offer interesting possibilities. Stemming from Cyanamid's acrylonitrile, all are typical acrylo derivatives. Each has a propylamine group but varies in the other substituent, producing corresponding changes in physical properties. For example, as the substituent increases in size, vapor pressure decreases and solubility in non-polar solvents increases. Effect is seen in use as curing agents for epoxy resins where dimethylaminopropylamine provides rapid cure while diethyl and higher substituents offer greater pot life. These amines are useful in forming surface active agents. Cationics and nonionics are produced by reaction with fatty acids and have been employed as emulsifying agents for waxes and as flotation agents. The amines also are useful intermediates for products such as germicides, pharmaceuticals and dyestuffs. The New Product Development Department offers these amines in semi-commercial quantities. The only exception is the di-n-butyl derivative, which is available in trial-lot quantities. For data sheets, samples or price information on any of these amines, a coupon is attached for your convenience. (No. 4)



## "Cogitations"

300,000 turkeys are estimated to have been lost last year by death from erysipelas. *Erysipelothrix rhusiopathiae* is the culprit, which also produces the disease in swine and an erysipeloid infection in man. A new vaccine, DUOVAX® erysipelas bacterin *Lederle*, produced by Cyanamid's Lederle Laboratories Division, provides effective control of erysipelas in turkeys—with the added advantage that there is no danger of infecting vaccinator or the turkey houses as was possible with the former serum and culture type vaccine. (No. 5)

**Anti-static agent CATIONIC SP** is a boon to processors of materials such as textiles, plastics, paper, and glass since it is applied easily and eliminates troublesome static. Added to plastic compositions, it prevents accumulation of strongly adhering dust on the finished products. CATIONIC SP is one of a group of Cyanamid's surface active agents. These polar-non-polar chemicals change the behavior of textiles, metals, oily materials, and fine powders by forming an extremely thin molecular layer on their surfaces. Usually, a very small percentage is all that is required. A Cyanamid surface active agent may be used to change the surface characteristics of a product easily, and improve its properties greatly. (No. 6)

**The ultraviolet component** of sunshine often causes discoloration and embrittlement in lacquers and plastics, checking and crazing in rubber, color changes in dyes and pigments, loss of strength in textiles, and blistering on tender skins. A small group of chemicals (substituted benzophenones) has been found to provide efficient protection against U. V. degradation. In particular, Cyanamid's U. V. ABSORBER 9, which is the 2-hydroxy-4-methoxy-benzophenone, is unusually effective. It absorbs harmful U. V. and converts it into harmless heat without fluorescence. New Product Bulletin #31, giving pertinent data regarding U. V. ABSORBER 9 and other related U. V. absorbers, is available on request. (No. 7)

**More information** on any of the products mentioned in these pages is available on request. Write to "Chemical Newsfront," American Cyanamid Company, 30 Rockefeller Plaza, New York 20, N. Y., or use the coupon below—simply checking the items on which you wish additional information.



**SEND** more information on the following items mentioned in the January, 1955 issue of LIFE on the Chemical Newsfront:

C. E.

No. 1, 2, 3, 4, 5, 6, 7.

Literature  Prices  Sample  of \_\_\_\_\_

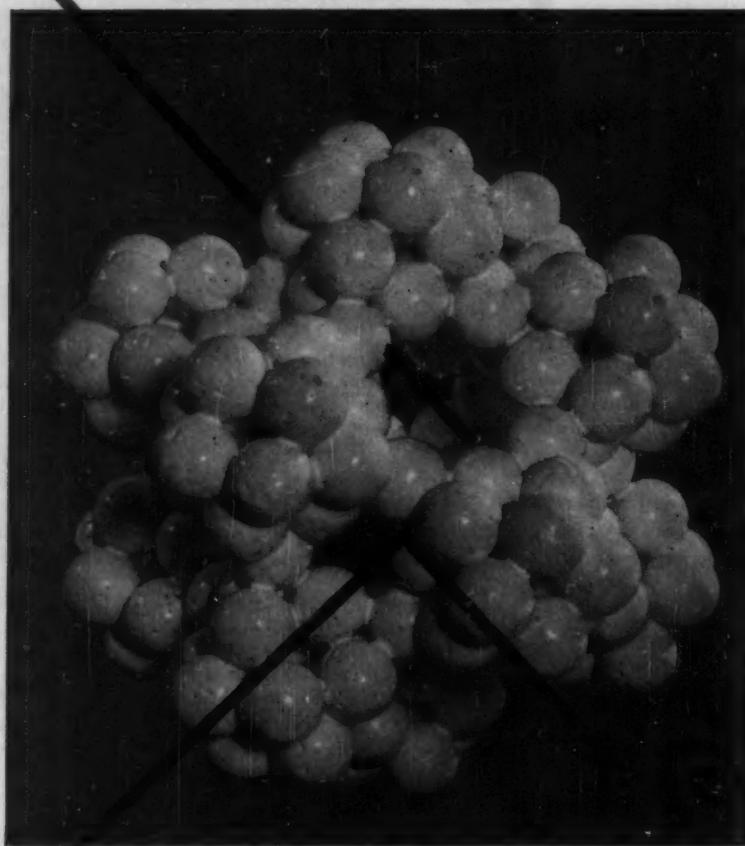
Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

Small molecules get caught . . .



Big molecules bounce off, to . . .

## Separate Men From Boys

**Uniformly sized pores of molecular dimensions permit Linde's synthetic zeolites to adsorb or reject materials on a novel basis—difference in molecular size.**

Molecular Sieves—Linde Air Products' new selective adsorbent—are precisely what their name implies: they present to a mixture of chemicals a surface systematically dotted with holes of equal molecular diameters. Molecules small

enough to fit through the holes are "adsorbed," molecules too big are thrown off—in a sort of molecular pin ball machine with big and small marbles rolling around, over and through openings large enough to admit only the smaller ones.

Commercial potential of this size-selectivity lies in the ability to separate straight-chain aliphatics from either branched-chain or cyclic aliphatics, or from aromatics, purely on the basis of their respective physical contours.

► **More to the Story**—The "Molecular Sieves" have selective powers that don't stop at sorting small molecules from big, however. Size measurement is merely their first and most significant criterion for separation and determines which molecules will be subject to further classification inside the zeolite crystal.

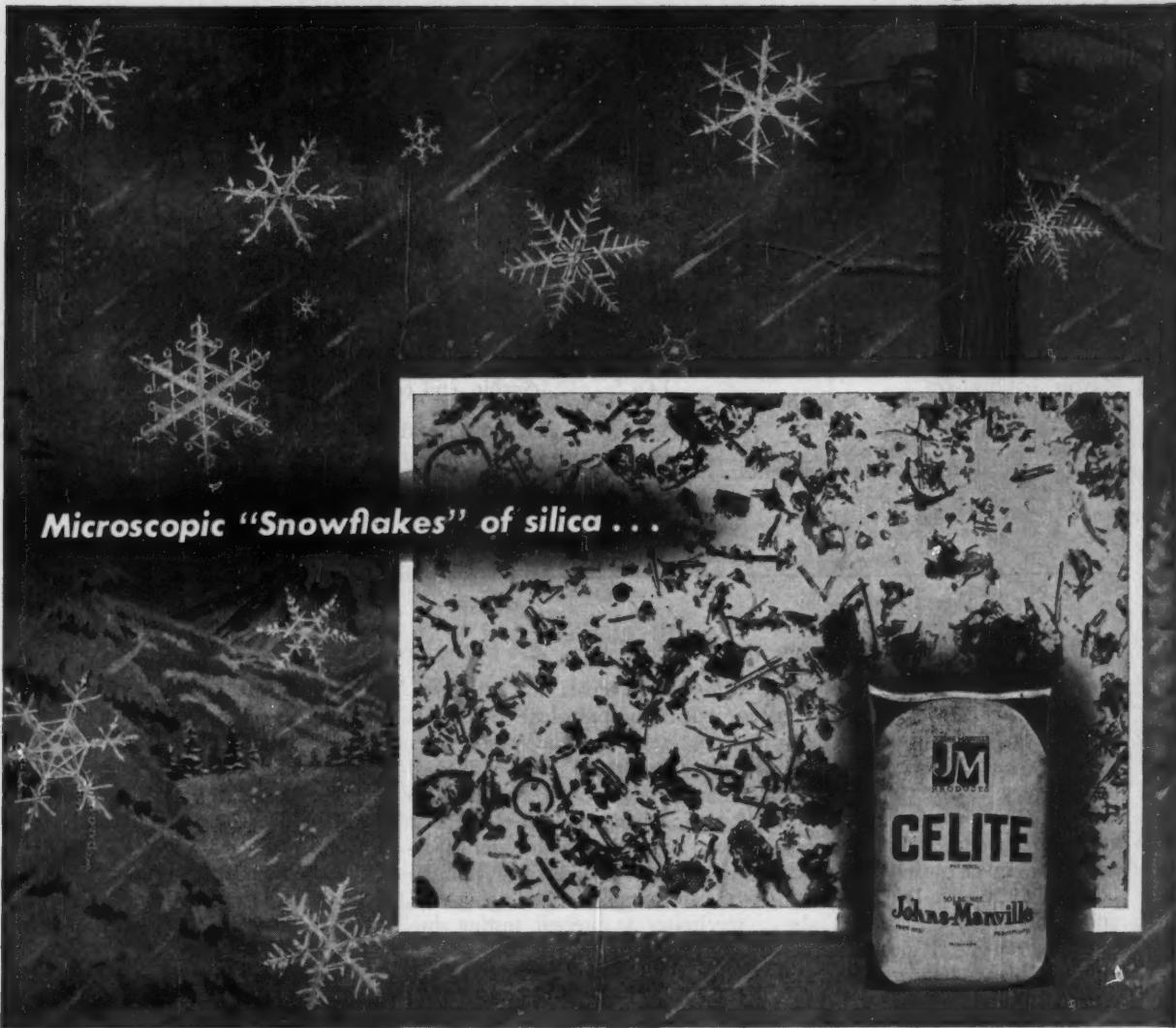
Attractive forces, acting on the molecules which do get through the pores, produce a screening action which adds considerably to MS' prowess as selective adsorbents. Components most strongly attracted will tend to remain within the crystal—others less affected will tend to "leave by the back door".

Molecular Sieves can, for instance, preferentially\* adsorb polar from non-polar materials, unsaturates from saturates and water from anything else regardless of size or polarity.

► **Moving Up**—This ability to discriminate closely among components of a mixture on the basis of size and polarity could put selective adsorption into the same class of importance with distillation as a means of separating chemicals. Molecular Sieves have, in fact, a significant advantage over the older unit operation and over their fellow adsorbents: they work independently of boiling points, can separate substances with identical boiling points but different molecular sizes and/or polarity.

Even the commonly used adsorbents—alumina, silica gel and activated carbon—are influenced by boiling points, tending to adsorb the higher boiling components of

\* We say preferentially because these last-mentioned separations, based as they are on a competition among electronic attractions rather than physical size, cannot give the sharp cuts that the sieve action does. The equilibria attained, however, are definitely in favor of polar and unsaturated compounds.



## Celite's diatomite structure steps up performance in paints—plastics—polishes... hundreds of other products

MICROSCOPIC PARTICLES of Celite\* do a man-size job of stepping up performance for many of America's leading products. Here is how the unique structure of Celite Diatomite Powders may add more beauty, longer life, greater efficiency to *your* products, too.

For example, the spiny, irregularly shaped particles contribute surface characteristics which make them the outstanding flattening agent in paints. Again, because of their structure, Celite particles are widely used as a

mild, non-scratching abrasive in finest quality auto, silver and glass polishes. Or consider molded plastics, where the strength and durability of Celite particles add life and beauty to surface finish.

Moreover, Celite particles in mass have great bulk per unit weight, so they are invaluable for extending, dispersing or fluffing up dry powders. They have high absorptive capacity, too, so they keep powders free-flowing, they serve as a medium for shipping

or storing liquids in a dry form.

Which of the many Celite advantages can you use to build product performance or cut production costs? A Johns-Manville Celite Engineer will gladly discuss your problem, without obligation. For his services or more information, simply write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

\*Celite is Johns-Manville's registered Trade Mark for its diatomaceous silica products.



# Johns-Manville CELITE

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VERSATILE MINERAL FILLER

products on these pages this month made news . . .

|  |      |  |      |
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| Selective adsorbent sorts by size.....         | 136A | Lighter-colored <i>m</i> -phenols..... | 144C |
| Fibrous rubber.....                            | 140A | Teflon adhesive.....                   | 144D |
| Ready-to-foam silicone powder.....             | 140B | All-purpose pesticide emulsifier.....  | 144E |
| Coagulant speeds solids separation.....        | 142A | Nylon hardens plastic tools.....       | 144F |
| Mud stabilizer cuts oil drilling time.....     | 142B | Heat-resistant laminates.....          | 144G |
| Rayon bandwagon.....                           | 142C | Sorbic acid controls mold growth.....  | 144H |
| Arnel—a new fiber.....                         | 144A | Lysergic acid synthesized.....         | 144I |
| High temperature molding compound.....         | 144B | Water and heat-proof grease.....       | 144J |

. . . For more about any item, use Reader Service postcard

a mixture in preference to the lower boiling ones.

► **Still More**—Topping off Molecular Sieves' most important virtues is their great adsorptive capacity at low concentrations of adsorbate and at high temperatures. Linde's product has a higher capacity for water below 30% relative humidity than either silica gel or activated alumina and can adsorb most materials at much higher temperatures than either.

► **Hydrocarbon Separation**—Because of their small and uniform pore size Molecular Sieves can effect separations between organic materials difficult to obtain by other methods. Straight chain aliphatics can be picked almost quantitatively out of mixtures highly concentrated in cyclic and branched chain compounds—n-heptane from methylcyclohexane, n-tetradecane from benzene.

► **Gas Purification**—Their affinity for polar compounds enables the sieves to remove from gas streams traces of CO, CO<sub>2</sub>, H<sub>2</sub>S, SO<sub>2</sub>, NH<sub>3</sub> and mercaptans—chemicals which poison catalysts, inhibit reactions, cause corrosion, foul equipment, or are toxic.

► **Waste Gas Recovery**—High selectivity for unsaturates plus high capacity at low concentrations and high temperatures add up to the sieves' facility to capture the 0.5-

10% of materials like ethylene, acetylene and propylene which normally escape in the waste gases (mostly saturates) from refineries, chemical plants and coke-ovens.

► **Static Drying of Gases**—Molecular Sieves, with their high water capacity even at extremely low humidities, are suitable for packaging with machinery to prevent rusting dur-

ing shipment or storage, or with drugs, foods and other materials subject to mildew. Far more drying is possible than with other desiccants; conversely, less adsorbent will be needed to attain the same degree of drying.

► **Dynamic Drying of Gases**—The sieves have several advantages here:

- They dry to dew points below -100 F.

- They dry at temperatures of 200 F. and above, can operate without removal of heat of adsorption save on tower cooling.

- They dry efficiently at high gas velocities, give large throughput with small equipment.

► **Drying of Liquids**—MS have high capacity even for traces of water, can give very dry liquids. So demanding is their appetite for water above all else that they can effectively dry even polar liquids like alcohols and amines.

► **Cost High?**—At first glance MS' price of \$1.95 a lb. looks a bit steep in the face of activated carbon (adsorption grade) at 60-70¢ and silica gel at 28-40¢. These figures will not provide a fair comparison where Linde's adsorbent shows promise in effecting separations and material recoveries which carbon and silica gel have not proved capable of or, at best, have not accomplished with the same efficiency. In the drying of gases, for example, Molec-

**Molecular Sieves Will . . .**  
**... Quantitatively Separate**  
Straight chain aliphatics  
from  
Branched chains  
Cyclics  
Aromatics  
**... Preferentially Adsorb**  
Unsaturates and  
Polar compounds  
from  
Saturates and  
Non-polar compounds  
**... Operate Economically**  
At high capacity  
At low concentrations  
At high temperatures

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- Chlorination and Oxidation Derivatives of Toluene (Benzyl Chloride, Benzaldehyde, Benzoic Acid) for dyes, sanitizers, drugs and cosmetics
- Other Organic Intermediates for a wide variety of products

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## CHEMICALS . . .

ular Sieves' three- to four-fold greater water capacity advantage, pound for pound, over silica gel must be reckoned with in discussing costs. Another example: Sieves' 2-1 edge over carbon in acetylene adsorption.

► Inside the Sieves—Linde's Molecular Sieves are not new chemically. Certain naturally-occurring zeolites have similar properties but are too scarce to serve as commercial adsorbents. In synthesizing a satisfactory substitute for the natural minerals, Linde has produced two basic crystalline types—a sodium and a calcium alumina-silicate.

Each consists of a large number of small cavities interconnected by smaller holes, or pores. The sodium zeolite, Type 4A, has pores 4 Angstroms in diameter; the other, Type 5A, measures 5 Angstroms.

The cavities are molecular sized—10 Angstroms in diameter—and constitute a void which is half the volume occupied by each crystal.

► Conditioning—Originally these cavities contained water of hydration which was driven from the zeolite crystals without altering their rugged physical structure, to "condition" the sieves for subsequent adsorption. As the molecular water leaves the crystal it sets up electronic forces within the cavities which determine how much of which molecules will remain locked in the adsorbent.\*

Reactivation presents no problems—heating, gas purging and cooling are sufficient to recover any adsorbate and prepare the sieves for further adsorption. 136A

\* The missing waters of hydration are the reason why water is first in line for adsorption when the sieves are exposed to wet mixtures.

### Fibrous Rubber

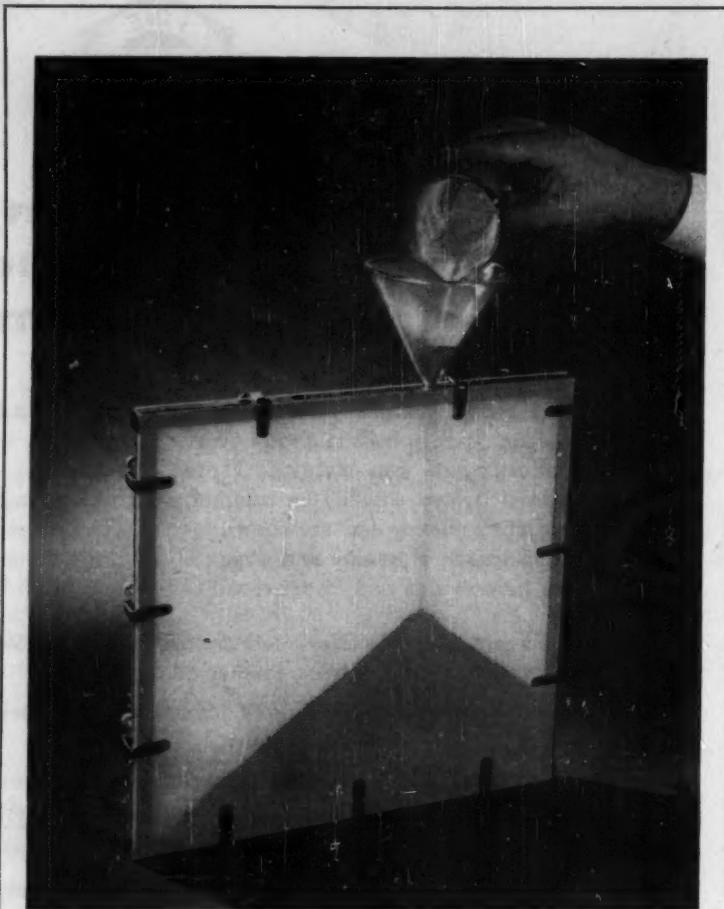
Web-like structure makes highly porous rubber products possible.

Rubber that can breathe—that's the claim for Filastic fibrous rubber. A new physical form of rubber, Filastic consists of many rubber fibers in random distribution and

bonded at their points of contact.

Milling natural or synthetic rubber with conventional curing agents, dissolving the composition in a

volatile solvent like naphtha and extruding the solution into the center of a rapidly moving air stream are the steps leading to web forma-



### Silicone Melts, Foams and Cures in One Step

Three silicone resin mixtures—R-7001, 7002 and 7003—are ready to use as is, contain resin, filler, blowing agent and catalyst. The mixes liquefy, foam and harden by themselves when heat is applied to produce low density foams which are stable and serviceable as high as 700 F., have good electrical and thermal conductivities, and water adsorption properties.

Heat resistance: Stable at temperatures where foamed organic resins fail in relatively short time. Heat distortion point greater than 700 F. Non-flammable in open flame.

Thermal conductivity: 0.3 Btu/hr./sq. ft./F./in.

Water absorption: 2.3% after 24-hr. immersion.

Compressive strength: 100-300 psi at 77 F.; 20-80 psi. at 500 F.

Fabrication: Cast in blocks or sheets of foam; made in sandwich structure; or foamed in place to the desired shape. Can be cut to shape with woodworking tools. Only negligible pressure is exerted during expansion—molds may be light weight and don't need preheating (see cut).

Cost: About \$5 a lb. for ready-to-foam powders.—Dow Corning Corp., Midland, Mich. 140B

**B & A**  
**PURIFIED**  
**AMMONIUM**  
**OXALATE**  
**Granular**

PHYSICAL AND CHEMICAL PROPERTIES

|                              |  |
|------------------------------|--|
| Appearance.....              | fine white needle crystals   |
| Formula.....                 | $(\text{NH}_4)_2\text{C}_2\text{O}_4 \cdot \text{H}_2\text{O}$                                       |
| Molecular Weight.....        | 142.12   |
| Specific Gravity, 20° C..... | 1.5  |
| Solubility in water.....     | 2.5 grams / 100 grams H <sub>2</sub> O at 0° C.<br>11.8 grams / 100 grams H <sub>2</sub> O at 50° C. |
| Slightly soluble in alcohol  |  |
| Insoluble in ammonia         |  |

Typical Analysis:

|  |         |
|--|---------|
| Assay $(\text{NH}_4)_2\text{C}_2\text{O}_4 \cdot \text{H}_2\text{O}$ ..... | 99.5 %  |
| Insoluble in water.....  | 0.015 % |
| Nonvolatile.....   | 0.03 %  |
| Chloride (Cl).....   | 0.003 % |
| Sulfate (SO <sub>4</sub> ).....  | 0.02 %  |
| Heavy Metals (as Pb).....  | 0.002 % |
| Iron (Fe).....   | 0.001 % |

Screen Size: Thru 40 mesh..... 90 %

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Note the analysis and physical properties of B&A Purified Ammonium Oxalate and see where this superior fine chemical

fits into your production schedule. For special uses requiring extra high purity, investigate B&A Reagent Grade Ammonium Oxalate.

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## CHEMICALS . . .

tion (something like the spinning of cellulose acetate and nylon). The air stream disrupts the extruded rubber to form numerous fibers, blows them upward in a chamber and deposits them on a moving screen in the form of a layer which is treated with talc and cured.

So strongly linked are these fibers that the rubber layer may be sewn, tacked, stapled and cut at the edge without forming a running tear. This fibrous structure also accounts for high porosity, low density and resilience.

Filastic would seem to have

much to offer the manufacturer of cushion innersoles, wearing apparel and rainwear which is water repellent yet capable of passing water vapor.—American Viscose Corp., Philadelphia 3, Pa. 140A

### Cut Oil Drilling Time

Mud stabilizer helps achieve drilling rate of 180 ft. a day at mud cost of 90¢ a ft.

Filcon SPF, a new oil well drilling compound, cuts by ten days

the drilling time required by other mud types—such as gypsum and lime—for similar wells.

Five 10,000 ft. Montana test wells were drilled at an average daily rate of 182 ft. using Filcon SPF and carboxymethyl cellulose. Mud costs per foot—\$0.906. Mud properties were stable and holes in excellent condition throughout the drilling despite salt concentrations which varied from 2,300 to 96,000 ppm.

Operating on a new principle, SPF stabilizes viscosities and gel strengths of drilling muds. A high molecular weight phenol formaldehyde resin, SPF has high tolerance for  $\text{CaSO}_4$  and salt contaminants, is especially useful for piercing salt or anhydride sections.—Monsanto Chemical Co., St. Louis 4, Mo.

142B



### Coagulant Peps Up Solids Separation

Industry has a new flocculating agent for settling and filtering water dispersed solids—Separan 2610. Intriguing benefits claimed for Separan in mining operations:

**Higher filtration rates:** The photos above show two vacuum filtration test leaves through which portions of a slurry (50% solids) have been filtering for the same period of time. One slurry portion had been previously treated with 0.01% Separan 2610 by weight of dry solids; the other portion was not treated. Greater coagulation—and faster filtration—of the treated slurry is quite evident from the pictures. Results of this test, if projected directly to industrial dimensions (a valid extrapolation when dealing with plant

vacuum leaf filters), read this way: untreated slurry—1,044 lb. solids/day/sq. ft.; Separan-treated slurry—5,900 lb. solids/day/sq. ft.

**Decreased material losses:** as much as 80%, with product recovery up 5%.

**Effective over wide pH range.**

**Better overhead clarity in settling operations:** as much as five-fold.

**Effective in small doses:** as little as one-half part per million parts dispersed solids. High coagulation capacity permits a thirty-fold reduction in some cases, in the amounts of flocculant needed, and affords savings in terms of equipment.

Drier filter cakes—as much as 5%—Dow Chemical Co., Midland, Mich.

142A

### Rayon Bandwagon

Super strength fiber gets big play from three major producers.

Three-count 'em—high tenacity rayon tire yarns are on the market now. First came Du Pont's Super Cordura in July, 1953; then North American Rayon's premium product in August, 1954; and now Super Rayflex by Avisco piles on the bandwagon.

Avisco claims "super strength and improved fatigue characteristics" for its yarn, is pricing it, along with Du Pont and North American, at 64¢ a lb., or 3¢ over ordinary high tenacity rayon.

There's been some interesting jockeying leading up to that price, however. For more than a year Du Pont, with the market all to itself, had been getting 67¢ a lb. for Super Cordura—a 6¢ bonus.

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**SAFETY SERVICE**—SOLVAY has long been recognized as the leader in the development of safety programs. SOLVAY engineers were also pioneers in the develop-

ment of special kits for emergency repairs to all types of SOLVAY Chlorine containers.

These SOLVAY Safety Kits may be purchased by SOLVAY Chlorine users . . . or in an emergency they may be borrowed without charge. Booklets describing these kits with detailed instruction are supplied at no cost. Also available without cost to SOLVAY customers, are Wall Safety Charts for employee instruction on safety practices . . . procedures to follow in an emergency . . . and location of nearest SOLVAY emergency kits.

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Para-dichlorobenzene • Chloroform • Ortho-dichlorobenzene • Methylene Chloride • Methyl Chloride • Carbon Tetrachloride

## CHEMICALS . . .

But within a month after North American came on the scene with a 64¢ a lb. rayon, Du Pont—you guessed it—sliced off 3¢ a lb.—American Viscose Corp., Philadelphia 3, Pa.; North American Rayon Corp., New York, N. Y.; E. I. du Pont de Nemours & Co., Wilmington 98, Del. 142C

### Arnel—A New Fiber

Cellulose triacetate will give other fibers a run for their money.

Celanese Corp., its acetate market cruelly eroded in recent years by wave after wave of newer synthetics—nylon, Orlon, Acrlan, etc.—bounces back with a glamour fiber of its own—Arnel.

First announced several months ago—Celanese called it X-100 (*Chem. Eng.*, Sept. 1954, page 154)—Arnel seems to offer plenty to the textile mills and to the consumer.

If you're a mill man you'll be interested to know that Arnel . . .

- Can be blended easily with other fibers.
- Is easy to dye and finish . . . a wide range of colors, all machine-washable, are obtainable with standard dyeing equipment and techniques, and with available but selected acetate dyes.

- Is not too expensive: price of staple Arnel is 55¢ a lb. vs. 34-39¢ for acetate and rayon and \$1.30-1.80 for Orlon, nylon, Dacron, Acrlan.

If you're a consumer you'll be glad to know that Arnel . . .

- Is machine-washable and dries at any temperature . . . keeps its shade and texture, doesn't shrink and stretch.

- Resists wrinkling, keeps its pleats . . . little or no need for ironing after drying . . . wrinkle performance in humid conditions comparable to the best new blends.

All in all, says Celanese, Arnel achieves the best balance yet among performance, appearance, versatility and price.—Celanese Corporation of America, New York 16, N. Y. 144A

## Product Briefs

Glass-filled silicone molding compound, Dow Corning 301, outperforms conventional organic molding compounds in the range of 400 F. Typical properties after molding 10 min. at 340 F.: tensile strength of 10,000-12,000 psi.; impact strength of 15-22 ft.-lb. per in. of notch. Dow Corning 301's flex strength ranges from 12,000-14,000 psi. at room temperature to 5,000 psi. at 392 F.—Dow Corning Corp., Midland, Mich. 144B

m-Phenols with improved color—less than 2 Gardner initially and only 3 Gardner after accelerated aging—are available through special processing which removes nearly all nitrogen bases. The lighter color of m-Phenols 220 will interest manufacturers of resins for casting and surface coating, metal cleaners, mercerizing penetrants, paint driers.—Carbide and Carbon Chemicals, New York 17, N. Y. 144C

Tough tape combines Teflon film with pressure-sensitive silicone adhesive. Called Scotch Tape No. 540, it defies temperature changes in the range of -65 to 350 F., features tensile strength of 15 lb. per in. of tape width and elongation of 300%, and resists many reactive chemicals.—Minnesota Mining and Mfg. Co., St. Paul, Minn. 144D

An approach to an ideal all-purpose pesticide emulsifier is Toximul 500. It handles at least a dozen toxicants, using only 3-4% of emulsifier over a range of water hardness of 50-1,000 ppm.—Ninol Laboratories, Inc., Chicago 16, Ill. 144E

Nylon powders improve abrasion resistance of epoxy and phenolic resins used in plastic tooling. Addition of 10-25% of powdered nylon ups epoxy abrasion resistance four times and suspends metallic fillers used to prevent exotherms (10 parts nylon hold

up 100 parts of iron, copper or brass in 100 parts of epoxy resin).—National Polymer Products, Inc., Reading, Pa. 144F

Higher heat resistance than any laminate developed to date—that's the claim for Synthane grade G-7, a silicone laminate combining heat stable silicone resins with layers of woven glass fabric. G-7 withstands constant temperatures of 400 F. without sacrifice to mechanical and electrical values.—Synthane Corp., Oaks, Pa. 144G

Sorbic acid is now being pushed for possible use in control of mold growth in food. Sublicenses under a Best Foods, Inc. patent will be granted by Carbide and Carbon to its sorbic acid customers. Commercial follow through on some of the promising applications uncovered in experimental work awaits only FDA approval (temporary permits for sorbic acid already granted to manufacturers of certain standardized cheeses). Sorbic's price -\$2.45 a lb.—is tempered by the fact that only small amounts are needed for effective mold control.—Carbide and Carbon Chemicals Co., New York 17, N. Y. 144H

Synthesis of lysergic acid—a basic compound in the structure of ergot alkaloids—has been achieved and may presage large-scale manufacture of chemicals—which are now quite rare—important to medicine because of their wide range of physiological action.—Eli Lilly and Co., Indianapolis 6, Ind. 144I

Water- and heat-proof greases are producible with a new class of silica-based thickeners called estersils. Greases built around estersils have mechanical stability, show little change of consistency with temperature.—E. I. du Pont de Nemours & Co., Wilmington 98, Del. 144J

## Polyamide Resin Is Versatile Adhesive ★★★★ General Mills Aliphats Boost Ore Output ★★★★ Wheatus to Chemicals!

The All-Around Utility of General Mills Polyamide Resins is so well recognized among adhesive formulators that this material is now a standard commodity in the field.

General Mills Polyamide Resins may be applied as heat-seal adhesive, by either hot melt or solvent solution technique. They bond at moderate temperatures. For example, Polyamide Resin 95 bonds at 80 to 100°C. This means that heat won't damage the material on which it's used. Important adhesive uses of Polyamide Resins include: paper labels, foil, cellophane, packaging (both flexible and rigid), shoes, book and magazine covers, and many others.

One of the newest uses of Polyamide Resins is for metal to metal bonds. Polyamide Resins 90 and 100 are used to join metal parts where high peel strength is needed and extreme rigidity is not important. This bond is highly resistant to oils, commercial antifreeze, wax emulsions, detergents, and many other commercial products.

Among their many other desirable characteristics, Polyamide Resins are non-blocking, thermoplastic, have good heat and color stability. They are easily applied because they have sharp and relatively low melting points. Naturally they also set up quickly.

Polyamide Resins 93 and 94 are designed for solvent coatings. They have excellent heat-sealing and moisture-resistance properties. They are frequently used for hot melt application where solvents are undesirable. Polyamide Resin 95 is specially compounded to give protective coatings with superior anti-blocking properties and resistance to moisture vapor. All Polyamide Resins may be modified by blending to give either a soft, pliable material or one that is hard and tough.

For additional information on General Mills Polyamide Resins, please mail the coupon below.

★★★★★

**Mineral Ore Output** by froth flotation is on the increase, and General Mills assisted in this development with Aliphats specifically designed for ore flotation. These Aliphats are inexpensive fatty acids.

Aliphat 44-E, for example, is a special mixture primarily composed of oleic and linoleic acids. As a result, it has an excellent record of performance as a direct replacement for the more expensive oleic acid in flotation of fluorspar. Aliphat 44-E has good interface characteristics, resulting in excellent concentrate purity, good recovery, and decreased middlings load. Another General Mills Aliphat, 44-A, gives top results in beneficiation of barite and spodumene.

In addition to these and other fatty acids, General Mills offers a line of fatty nitrogen compounds, too. These

compounds are of benefit in flotation of phosphate, potash, feldspar, and (potentially) iron ore. For technical information on General Mills Aliphats or fatty nitrogen compounds, just mail the coupon below.

★★★★★

**What's General Mills Doing** in the chemical business? That question is sometimes asked by those who know General Mills best for its Wheatus, Bisquick, Gold Medal Flour, or Betty Crocker Cake Mixes.

Here's the answer! These food products all came from agricultural raw materials—original source of the bulk of General Mills industrial chemicals. The General Mills Chemical Division . . . now an outstanding industrial chemical source . . . was the natural outgrowth of agricultural research and its application to the chemical field.

The research facilities and personnel that developed those food products . . . the quality controls that made them reliable . . . and the constant improvements that made them famous—all were suited to the chemical field.

So, General Mills brought to chemicals the outstanding organization trained in the field of agricultural resources—plus the high standards and product-control methods it pioneered in foods and feeds. This organization is now dedicated to the production of top-quality oils, fatty acids, and organic chemical derivatives for you.

If you would like information on any of the General Mills industrial chemicals, please mail the coupon below.



From Wheatus to industrial chemicals was not a big production step for General Mills. The "know-how" that produced Wheatus played a large part in developing Polyamide Resins and other chemical products.

## General Mills

### CHEMICAL DIVISION

KANKAKEE, ILLINOIS

Please send me additional technical information for the products checked below.

Fatty Nitrogen Compounds  
 Polyamide Resins

Fatty Acids:  
 Aliphat 44-E  
 Aliphat 44-A

NAME \_\_\_\_\_

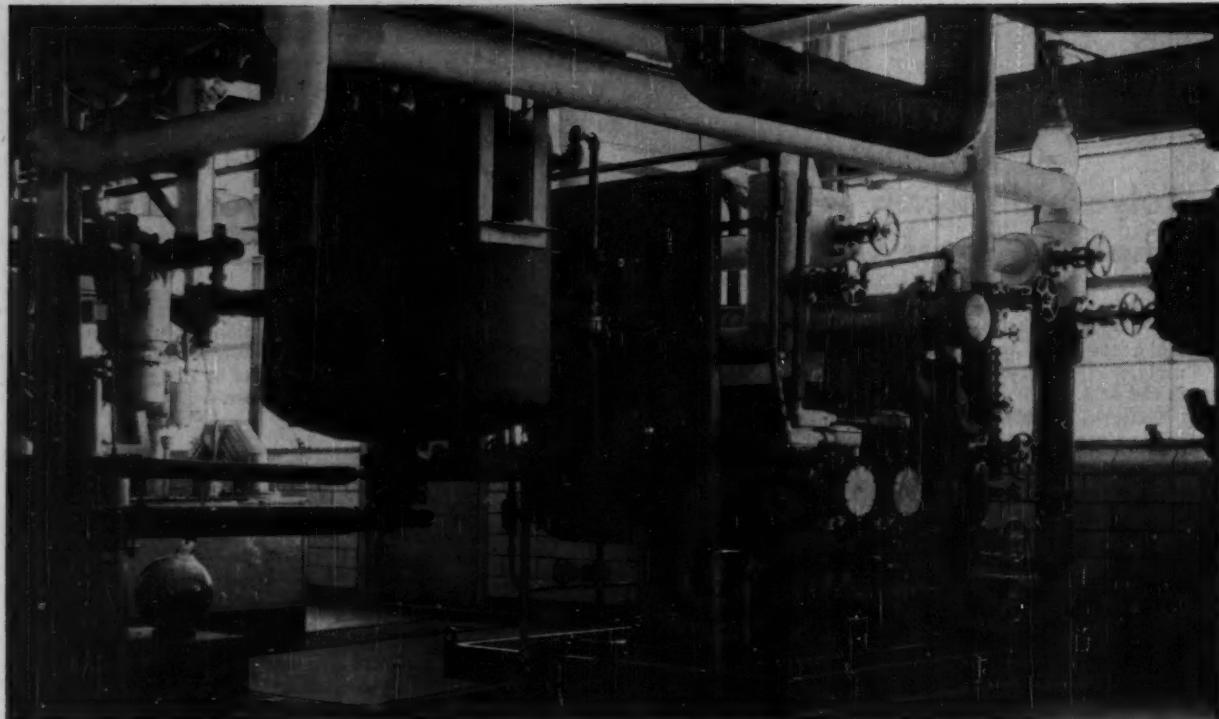
FIRM \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_

*progress thru research*

E-1-54



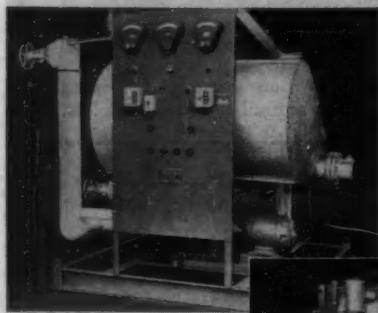
Heating and cooling system in service on process kettle, one of four units installed, for explosion-proof service. (Photo courtesy Kodak Park Works, Eastman Kodak Company)

## *for Indirect Heating—STRUTHERS WELLS* ELECTRICALLY HEATED EQUIPMENT

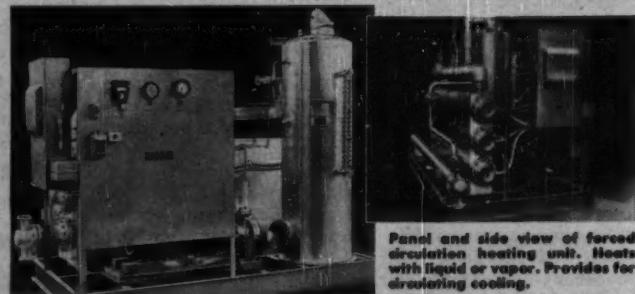
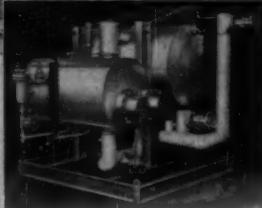
Struthers Wells equipment for indirect heating operations—utilizing electric heat—can be supplied in a range of standard sizes to about 1,000,000 Btu., and in larger units where required. Two types are available: 1. employing a pump circulated heating medium for liquid or vapor heating, which also lends itself to circulating cooling, and 2. utilizing a vapor medium (usually Dowtherm). Heated tank has natural circulation—condensate returns by gravity. Pump circulation may be used for cooling or condensate return.

Equipment is supplied as a complete package—with piping, wiring and insulation—ready to operate. Direct fired heaters are also available in standard sizes to 40,000,000 Btu. per hour capacity.

Write today for complete data.



Views of vaporizer type of Dowtherm heater, with pump and capacity tank.



Panel and side view of forced circulation heating unit. Heats with liquid or vapor. Provides for circulating cooling.

**Struthers  
Wells**

**STRUTHERS WELLS CORPORATION**  
**WARREN, PENNSYLVANIA**  
**PLANTS AT WARREN AND TITUSVILLE, PA.**

*"A Pre-eminent Manufacturer in High Temperature Heating"*

# How corrosion is controlled in making a famous Chlorinated Organic Weed-Killer

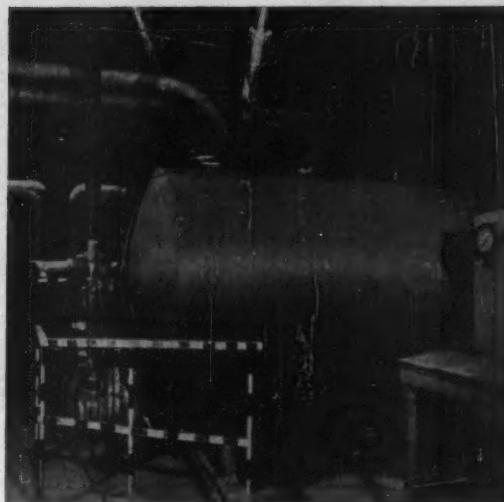
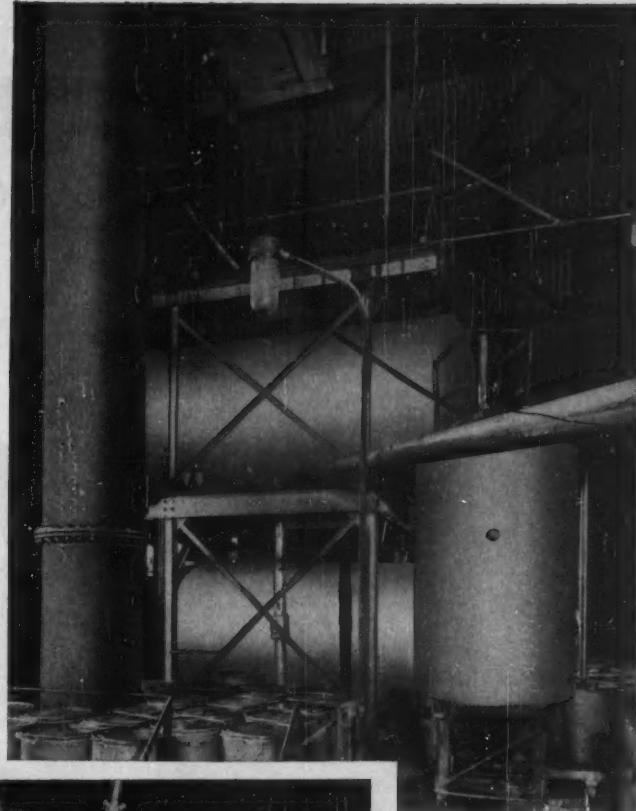
When Pittsburgh Coke & Chemical Company embarked on the manufacture of the herbicide 2,4-D some years ago, they were confronted by some formidable corrosion and contamination problems.

Making 2,4-D calls for the chlorination of phenol to dichlorophenol, then reacting this with monochloracetic acid to form the 2,4-D acid.

Small amounts of hydrochloric acid form during chlorination, and, together with unreacted chlorine, constitute a corrosion threat which persists through the distillation stage. And beyond the fractionation stage, even small amounts of corrosion products, if allowed to form, will affect color and purity.

When operations were still in the pilot plant, trouble was experienced with corrosion of certain equipment items. Inco's Corrosion Engineers were called in and corrosion tests were performed at various equipment sites. As a result of the tests, nickel pipe and fittings were installed in the system and eventually the use of Nickel and Nickel-Clad Steel was extended to such important items as the still, steam coils, fractionating tower, condenser and storage vessels used in making and handling dichlorophenol.

The tank for weighing pure dichlorophenol and such items as the reactor for making 2,4-D as well as stripping column, centrifuge and dryer are made of another high-nickel alloy, Monel. Most of the equipment has been in successful operation for four years.



Pure 2,4-D is separated from underchlorinated and over-chlorinated product in the solid Nickel fractionating column shown above. All the cuts are received in nickel or Nickel-Clad Steel tanks as well, to protect product purity.

A purer, drier dichlorophenol was the result when this Nickel still was installed at Pittsburgh Coke & Chemical to resist corrosion by chlorine and hydrochloric acid.

Do you have a corrosion or contamination problem connected with a chlorination operation? If so, Inco Nickel or a high-nickel alloy may very well be the answer. At any rate, write to Inco's Corrosion Engineering Section, stating your problem in detail. They will be glad to advise you without cost or obligation.

**THE INTERNATIONAL NICKEL COMPANY, INC.**  
67 Wall Street

New York 5, N. Y.



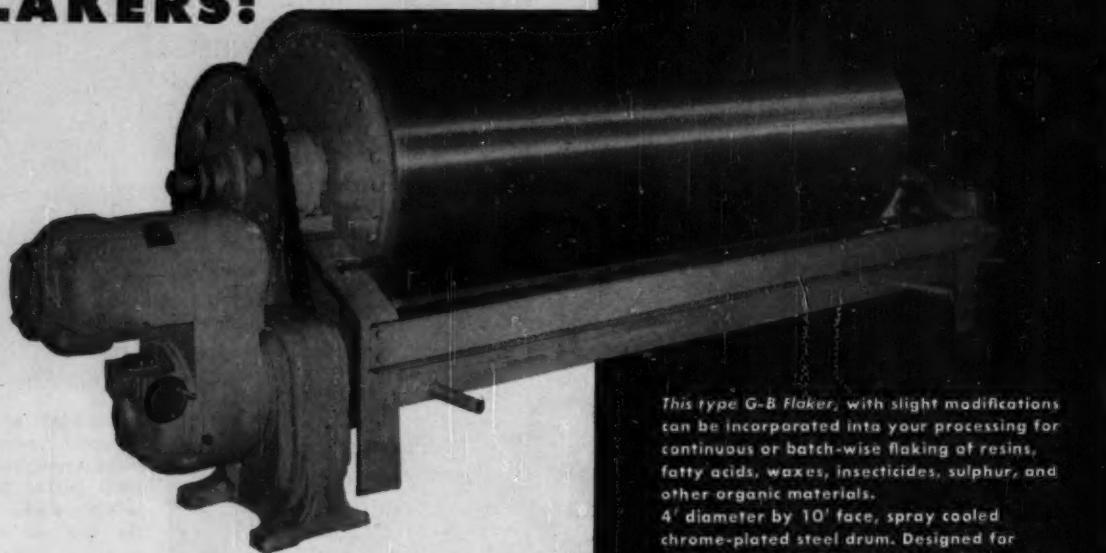
**Nickel Alloys**

MONEL® • "R"® MONEL • "K"® MONEL • "KR"® MONEL  
"S"® MONEL • INCONEL® • INCONEL "X"®  
INCONEL "W"® • INCOLOY® • NIMONIC® Alloys  
NICKEL • LOW CARBON NICKEL • DURANICKEL®



# GET DOWN LOW

**WITH NEW G-B  
LOWER COST  
FLAKERS!**



This type G-B Flaker, with slight modifications can be incorporated into your processing for continuous or batch-wise flaking of resins, fatty acids, waxes, insecticides, sulphur, and other organic materials.

4' diameter by 10' face, spray cooled chrome-plated steel drum. Designed for approximately 5,000 pounds capacity per hour. Equipped with pan levelling device to facilitate cleaning. Stainless steel discharge conveyor. Adjustable scraper blade. Simplified level control on pan. Variable speed drive, 3 RPM through 9 RPM range.

We can point to many instances where new, low *first cost* G-B designs have resulted in lower overall product flaking costs, too. This double-barrelled economy in flaker equipment design deserves your careful re-examination of your flaking costs as a means of product conversion. Phthalic anhydride, sulphur, benzene hexachloride, caustic, and resins of all types can be efficiently and economically processed by G-B flakers.

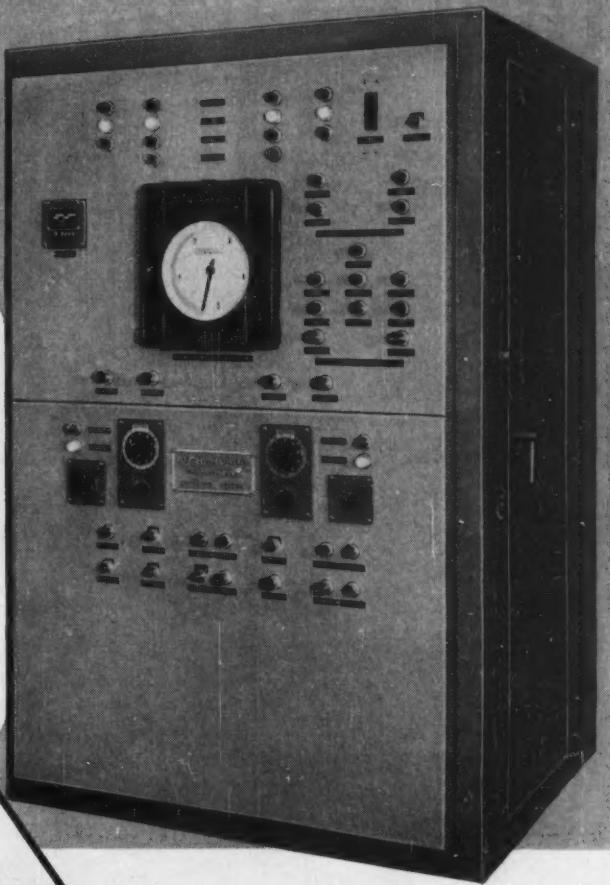
*Our pilot testing facilities are at your disposal...no obligation.*

**GOSLIN-BIRMINGHAM  
MANUFACTURING CO., INC.  
BIRMINGHAM • ALABAMA**



# PROPORTIONING SYSTEM IN NEW OIL PROCESS

Select-O-WEIGH®  
Dialed Weight Selection



**Richardson**  
**AUTOMATIC PROPORTIONING**

- . . . 50 years of automatic weighing experience covering more than 400 different materials
- . . . life-testing of electronic components in the lab, for maximum performance in the plant
- . . . materials flow research and test facilities to co-ordinate material characteristics with system design
- . . . a development lab working out new and better methods in automatic proportioning
- . . . integration of all equipment and accessories into a complete coordinated system
- . . . system completely wired and tested with test material before shipment
- . . . single responsibility for the entire system, with nationwide service facilities.

An experimental U. S. Bureau of Mines pilot plant utilizes the Richardson Select-O-Weigh Proportioning System in a new process of extracting oil from raw shale. The System's electrical panel board serves as a control center that can be run by a single operator who selects by dial settings the amount and types of shale to be drawn from storage bins to the scale via belt conveyors. The weight of each batch is indicated by a conveniently mounted dial head.

Component interlocks prevent out-of-sequence operation and insure continuous performance.

Other features are panel pilot lights that indicate each step of the operation, an electric counter that totals the number of weighings, and dust-tight walk-in panel construction with oil-tight controls. Operational control may be transferred from automatic to manual at any time, if this is desirable or necessary. This is the second of this type of system to be installed for this customer.

For complete case history file of Select-O-Weigh installations in industry, please ask for Bulletin 0351.

# Richardson

MATERIALS HANDLING BY WEIGHT SINCE 1902

**RICHARDSON SCALE COMPANY**  
Clifton, New Jersey

Atlanta • Boston • Buffalo • Chicago • Cincinnati • Detroit  
Houston • Memphis • Minneapolis • New York • Omaha  
Philadelphia • Pittsburgh • San Francisco • Wichita • Montreal  
Toronto • Havana • Mexico City • San Juan

© 1953

# THREE LOAD PROBLEMS SOLVED INEXPENSIVELY

**T**AYLOR Volumetric Load Measuring Elements are the practical answer to applications throughout industry where reliable accuracy at low cost is more important than microscopic precision. Rugged, dependable, unaffected by dirt or dust, they require the very minimum of maintenance. And while conventional methods of

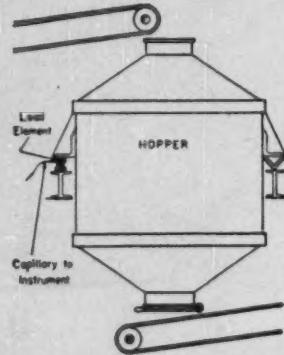
weighing have an initially higher order of accuracy, they may quickly deteriorate. In the long run therefore Taylor Volumetric Load Elements are more accurate—at a fraction of the cost of conventional instruments.

Write for **Bulletin 98232**. Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

**Problem:** To measure dependably and economically the weight of solids in a measuring hopper.

**Solution:** Taylor Spool Type Load Measuring Element.

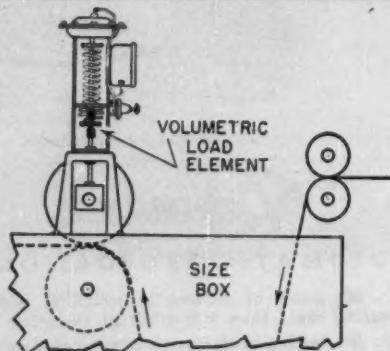
**Characteristics:** Range limits, 0-240,000 lbs. for compression loads, maximum load not to exceed 400,000 lbs. Applicable also to horizontal or vertical tanks containing corrosives or solids, making conventional level measuring devices impractical. Tension loads 0-30,000 lbs.



**Problem:** To measure accurately squeeze roll pressures on textile slashers to insure uniform penetration of size.

**Solution:** Diaphragm type load Measuring Element.

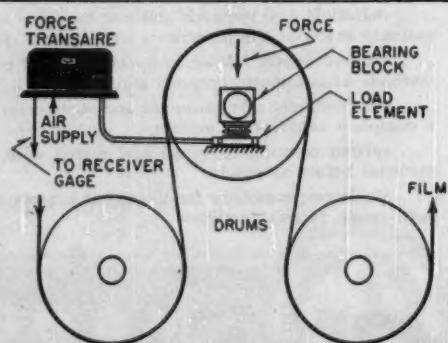
**Characteristics:** Range limits: 0-5,000 lbs., maximum load not to exceed 6,250 lbs. Compound ranges, tension -0- compression also available. Applicable to measure roll or nip pressures in calender stacks, press section and many other finishing operations involving processing of material between rolls.



**Problem:** To measure film tension within very close limits as a measure of "gain" or percentage of stretch.

**Solution:** TRANSAIR\* Volumetric Load Measuring Element.

**Characteristics:** Range limits: 0-300 lbs. in range spans as short as 30 lbs. Used in conjunction with a TRANSAIR Pressure Transmitter which sends an output air pressure to an indicating, recording, or controlling receiver proportional to the force applied. Applicable to film, paper, yarn or similar tension measuring requirements.



\*Reg. U. S. Pat. Off.

## Taylor Instruments MEAN ACCURACY FIRST



## His testing makes CHASE® Antimonial Admiralty Condenser Tubes the best you can buy!

**TOUGH** is the word for the Chase Expansion Test pictured above. A pin with a  $1\frac{1}{2}$ " per ft. taper is driven into the end of a Chase Condenser Tube which must withstand an increase of 20% in diameter.

This test is just one of many that Chase Tubes must pass.

Chase **ANTIMONIAL ADMIRALTY** Tubes must pass far sterner tests in the Chase Laboratories than they will ever encounter under normal tube usage. That's why they last for years in actual use. It pays to insist on Chase.

# Chase



BRASS & COPPER CO.

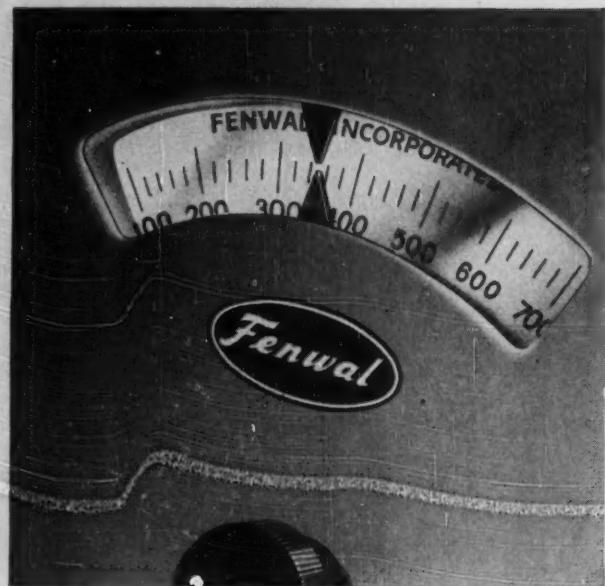
WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

**CHASE WAREHOUSE STOCKS:** Los Angeles, New Orleans  
Prompt Delivery from Cleveland and Waterbury Mills

*The Nation's Headquarters for Brass & Copper*

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| Boston    | Dallas     | Indianapolis | Minneapolis      | Philadelphia | St. Louis  | (sales office only) |

# Now . . . a new Temperature Indicator-Controller by Fenwal



**1. FENWAL'S NEW SERIES 540** is a remote Temperature Indicator-Controller that combines low cost with high accuracy over a temperature range of 100° to 700°F. Designed for ovens, packaging and processing equipment of all types, the new controller operates on a liquid-filled bulb and capillary system whose response to temperature changes is transmitted through a bellow to an indicating pointer. It may be flush-mounted or surface-mounted.

**2. "SET" AND "CHECK" ARE EASY.** Temperature setting pointer and bulb temperature pointer pivot on the same axis, indicating against the same scale face. This permits "glance" comparison of actual and set-point readings at considerable distance from the dial. An adjustable differential, variable between 0.8% and 4% of scale range, permits adjusting the operating bandwidth to balance closeness of control against slower cycling and longer equipment life.



**3. ACCURACY IS ASSURED.** Temperature indication is accurate to within 3% over the 100° to 700°F range, including the effects of ambient temperature in the range of 50° to 150°F. Accuracy increases for narrower ranges. Uniform control and accurate calibration are maintained with typical Fenwal precision in this new, popular-priced addition to a famous line of temperature control and detection devices.

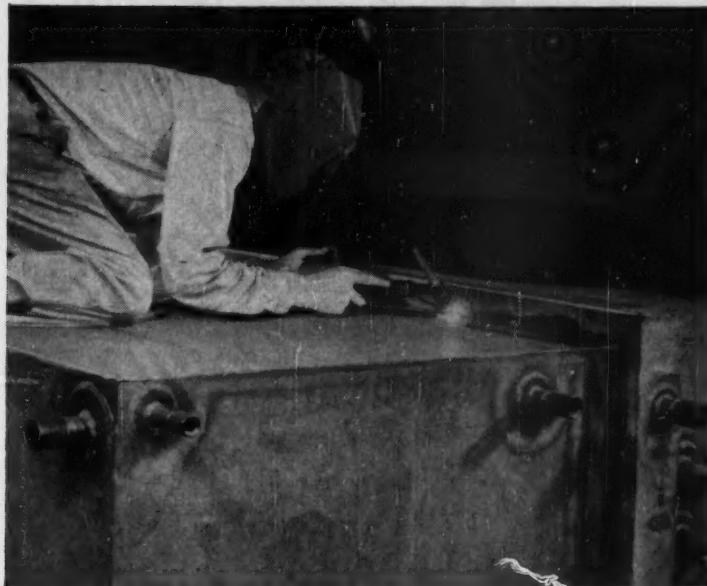


**4. SEND FOR NEW BULLETIN.** Get all the facts on how closely the new Series 540 meets your requirements for an economical, accurate indicator-controller. Write for comprehensive bulletin MC122. And remember, we're always ready to help in any problems concerning temperature control and detection. **Fenwal Incorporated, 161 Pleasant Street, Ashland, Mass.**



Controls Temperatures  
... Precisely

# CORROSION-RESISTANT EVERDUR QUADRUPLES LIFE OF DEGREASING TANK



**WELDING CHANNELS** on side of tank with EVERDUR-1010 Welding Rods. Fabricated in 3 sections, this tank was welded and assembled by Storts Welding Company, Meriden, Conn.

**Easy to work and weld, Everdur also proves adaptable to money-saving fabricating methods**

Trichlorethylene—the solvent used in this degreasing tank—may break down to form hydrochloric acid when heated in the presence of moisture.

So serious is the corrosion problem that tanks made of ferrous materials, for example, have lasted no more than two or three years in this service.

The manufacturer's problem? To find a material that would not only resist this acid corrosion but also lend itself to low-cost fabricating methods.

After consulting with Anaconda's Technical Department, the manufacturer decided to fabricate the tank of EVERDUR®—ANACONDA's Copper-Silicon Alloy. Fabricating costs were low and tank life is estimated to be over twelve years.

**Corrosion-resistant.** EVERDUR resists corrosive attack by hydrochloric acid. It can't rust. And it is unusually strong, tough and fatigue-resistant. What's more,

EVERDUR is . . .

*Easy to work.* You can work and form EVERDUR plate hot or cold. EVERDUR alloys are also available for forging and machining. Weldability? You'll find EVERDUR . . .

*Easy to weld, too.* The inert-gas shielded-arc methods produce high-quality welds at good speeds and moderate cost, and with minimum distortion. This tank was welded with the argon-shielded tungsten arc, using  $\frac{1}{8}$ " and  $\frac{5}{32}$ " diameter EVERDUR-1010 Welding Rods.

EVERDUR Copper-Silicon Alloys are available in plates, sheets, rods, wires, tubes, electrical conduit and casting ingots. Your own equipment or corrosion problem will be given careful attention by our Technical Department. Write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

\*Reg. U. S. Pat. Off.



DEGREASING TANK 30' long, 6' high and 2 1/2' wide and made of  $\frac{1}{8}$ " EVERDUR-1010 Sheet.

**EVERDUR**  
**ANACONDA®**  
COPPER-SILICON ALLOYS

Strong • Weldable • Workable • Corrosion-Resistant

*this is it!*



NEVILLE  
RESIN

*the  
special pale, low-odor  
Coumarone-Indene Resin*

PRESCRIBED FOR

**FREEZE-THAW STABLE PVAc EMULSION PAINTS**



**imparts freeze-thaw stability without  
inducing odor**



**gives better adhesion, especially to  
old paint films**



**offers greater economy**

**NEVILLE**

*Write for samples  
and data*

Only  insures these advantages in PVAc paints. Why? Because it is carefully manufactured from selected raw materials to produce its minimum odor and light color. In fact  has long been popular in an application where purity and minimum odor are "musts."

**NEVILLE CHEMICAL CO. • PITTSBURGH 25, PA.**

P-57

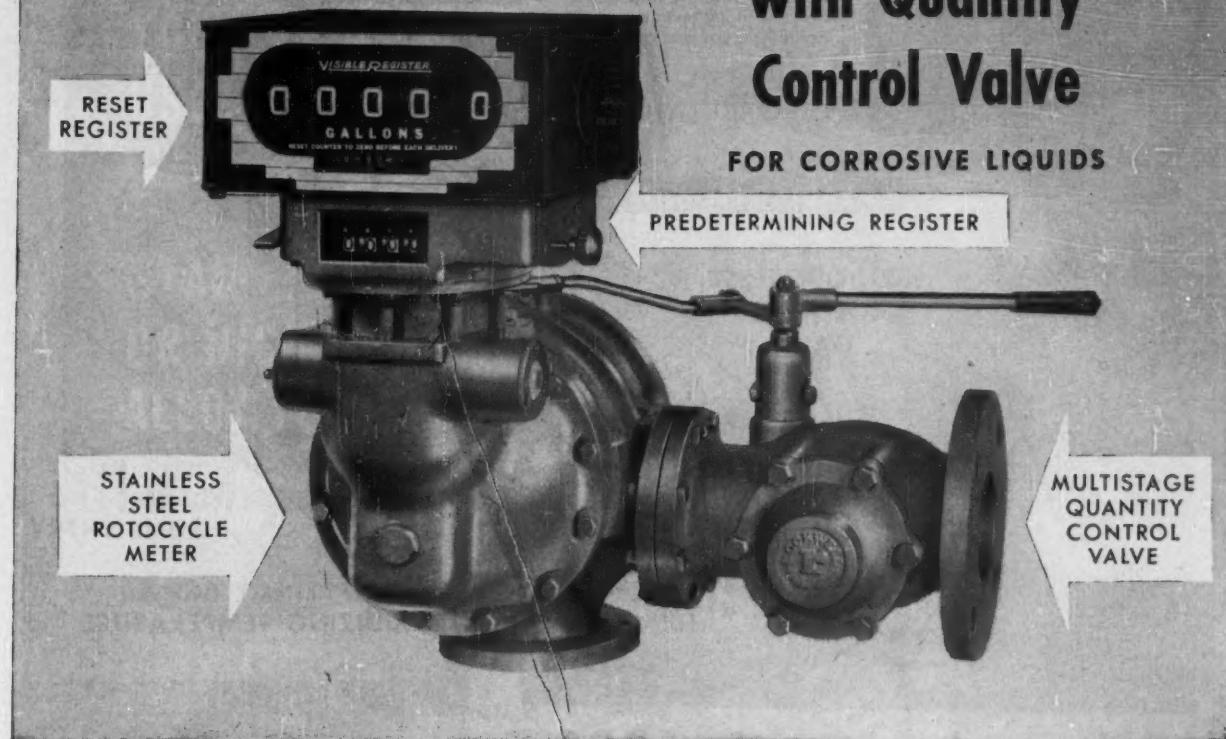
*Plants at Neville Island, Pa., and Anaheim, Cal.*

154

January 1955—CHEMICAL ENGINEERING

# IT'S NEW! "316" Stainless Steel Meter with Quantity Control Valve

FOR CORROSIVE LIQUIDS



## Controls Cost--Controls Quality

Here's a new money-saving tool for you who blend, batch or otherwise process alcohols, vegetable oils, deionized water and corrosive liquids. It's the popular all-stainless steel Rockwell Rotocycle meter fitted with a pre-determining register and an automatic shut-off valve. You just set the quantity you wish the meter to dispense and when this quantity has been measured, the flow is stopped. The stainless steel control valve is of the multi-stage type to avoid hydraulic shock. Use the handy coupon for full details.

**ALL TYPES OF INDUSTRIAL METERS** Rockwell makes all sizes and types of meters for use by industry. With them you can get positive metered accounting for a multitude of liquids. You can guard the quality of your formulations, keep tab on liquid inventories, have accurate records for cost control and tax analysis purposes. Now is the time to *meter and save*.

### CLIP COUPON—MAIL TODAY

Rockwell Manufacturing Company  
Pittsburgh 8, Pennsylvania

104A

Gentlemen:

I am interested in measuring \_\_\_\_\_ (Name of Liquid)

Pipe Size \_\_\_\_\_ "

Working Pressure \_\_\_\_\_ psi Temperature \_\_\_\_\_ °F max.

Max. Flow Rate \_\_\_\_\_ gpm Min. Flow Rate \_\_\_\_\_ gpm

YOUR NAME \_\_\_\_\_

COMPANY \_\_\_\_\_

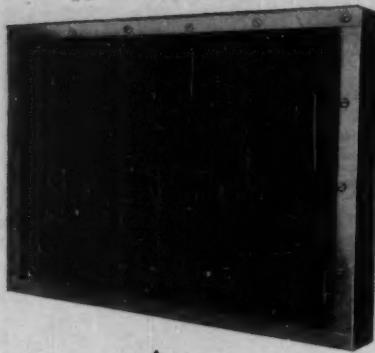
STREET \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

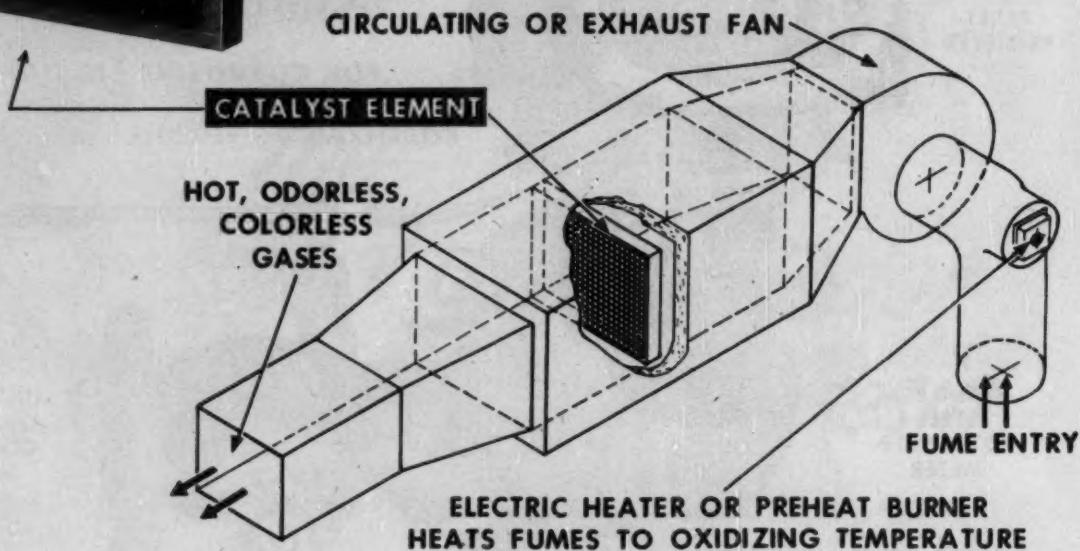
**ROCKWELL**  
**INDUSTRIAL**  
**METERS**



YOU CAN RELY ON ROCKWELL



**Basic Elements of Fume Combustion System** for eliminating odorous, poisonous, explosive or flammable fumes from industrial processes. The Catalytic Combustion Corp., Detroit, Mich., produces and installs systems that furnish useful heat for many operations . . . while routing smog, smells and noxious gases.



## At temperatures up to 1500°F

*Catalytic Combustion Units Using Nickel-Chromium Alloys*

## Operate Efficiently for Years

Scores of plant operators now liberate and use heat energy that, heretofore, went to waste . . .

And by the same means, these operators control air pollution and convert noxious or explosive fumes into odor-free harmless gases.

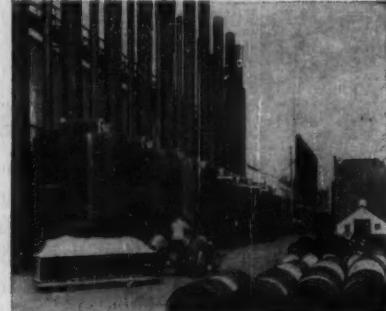
How? By catalytic oxidation on the industrial level. Thanks to a Catalytic Combustion Corporation development which utilizes the catalytic action of platinum and the heat-and-corrosion resistance of nickel-chromium alloys.

The drawing shows fundamentals of a catalytic fume combustion system, and the photograph shows a typical catalyst element, 18" x 24" x 2 1/8", weighing about 30 pounds.

The latter comprises a frame of 18-8 chromium-nickel stainless steel, and 16-mesh screen of 60-16 nickel-chromium alloy (ACI Type "HW"), containing mat of this alloy in the form of ribbon . . . two miles of it . . . 1/16" wide. Deposited on this mat is the catalytic medium, vital metallic platinum.

Screens and mat of the 60-16 nickel-chromium alloy resist both heat and corrosion to an extent that assures long life and efficiency at temperatures up to 1500°F. Moreover, thermal expansivity of the alloy is close enough to that of platinum to prevent spalling or flaking of the catalyst.

Hourly, the 2-mile alloy ribbon mat with its catalytic agent can



**Large Installation of Catalytic Combustion Units** . . . used to decompose irritating exhaust gases from production of phthalic anhydride at Detroit plant of Reichhold Chemicals Co. It comprises these two batteries of 10 units each, and eight similar units, not shown. Each incinerator processes 1200 cu. ft. of gas per minute, 24 hours daily. Ten initially installed in 1949 have now given more than 30,000 hours' service with no catalyst replacement.

handle up to 3000 pounds of most gases, and liberate heat at rates up to 800,000 B.T.U.

Nickel alloys may help you, too, improve your products or equipment. Whenever you face a metal problem, send us the details for our suggestions.



**THE INTERNATIONAL NICKEL COMPANY, INC.** 67 Wall Street  
New York 5, N.Y.

IF  
YOU  
USE

STAINLESS  
OR HIGH  
ALLOY TUBING

*this new booklet  
was written for you...*

TRENTWELD STAINLESS  
and HIGH ALLOY TUBING

1/8" to 40" O.D.



TRENT TUBE COMPANY

EAST TROY, WISCONSIN

Subsidiary of Crucible Steel Company of America

Whether you're an engineer who wants technical information in a hurry, or a new user of tubing looking for the full story of stainless and high-alloys, you'll find this booklet equally valuable.

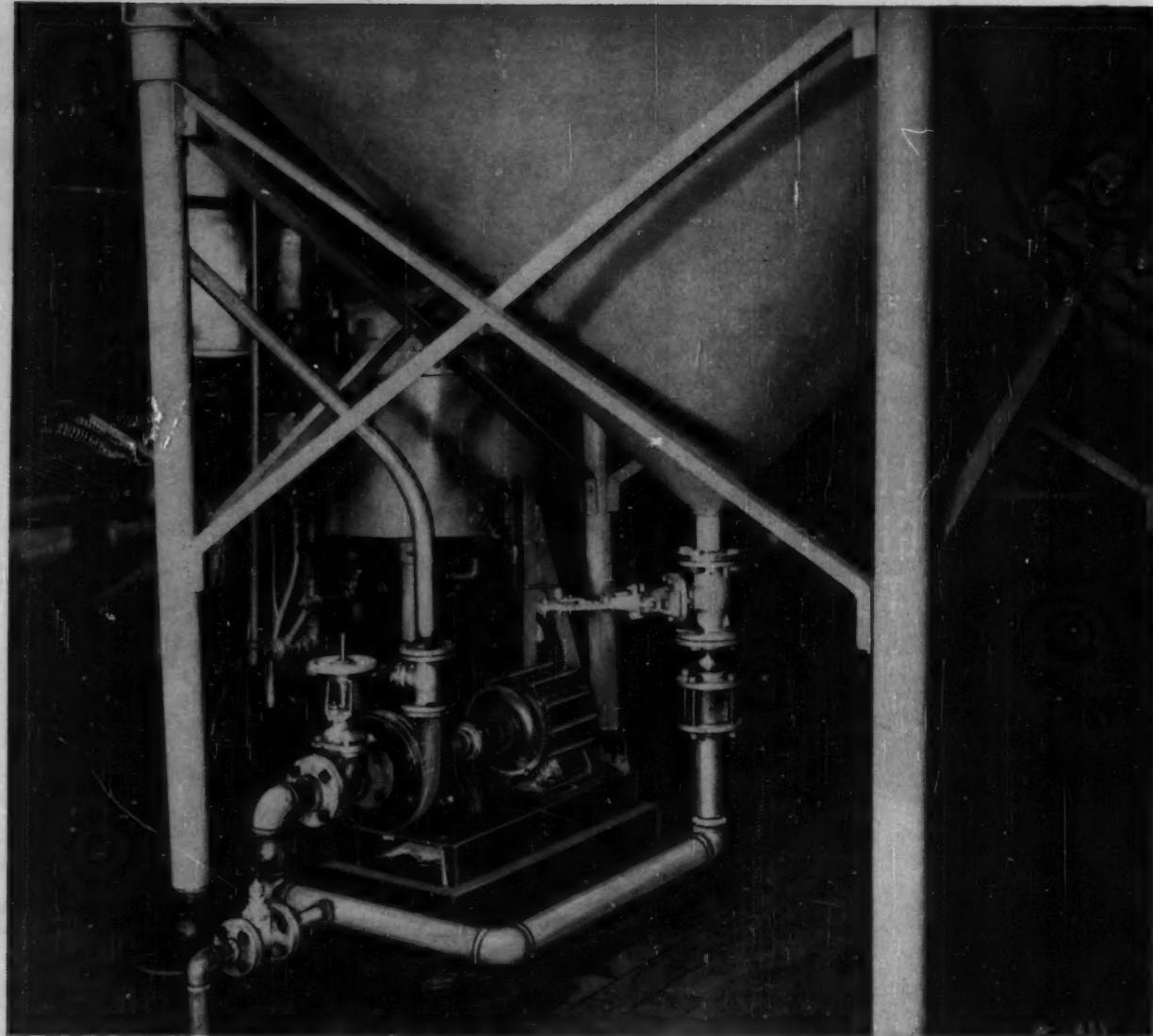
In it, discussed by classification, you'll find data on pressure, sanitary, mechanical, heat-resistant, ornamental and other forms of stainless and high-alloy welded tubing. There are engineering data on joining methods, welding techniques, bending and installation hints. Also included are complete tables of bursting pressures, physical and chemical properties of stainless steels and other alloys, and corrosion and temperature data. This is only a partial list of contents, but it will give you an idea of the wealth of pertinent, factual information the booklet contains.

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If you've got a pumping problem involving corrosive fluids, chances are you'll find the answer in a Worthite pump. Get all the facts on these rugged units by writing for Bulletin W-350-B16 to Worthington Corporation, Centrifugal Pump Division, Harrison, New Jersey. C.4.4

# WORTHINGTON



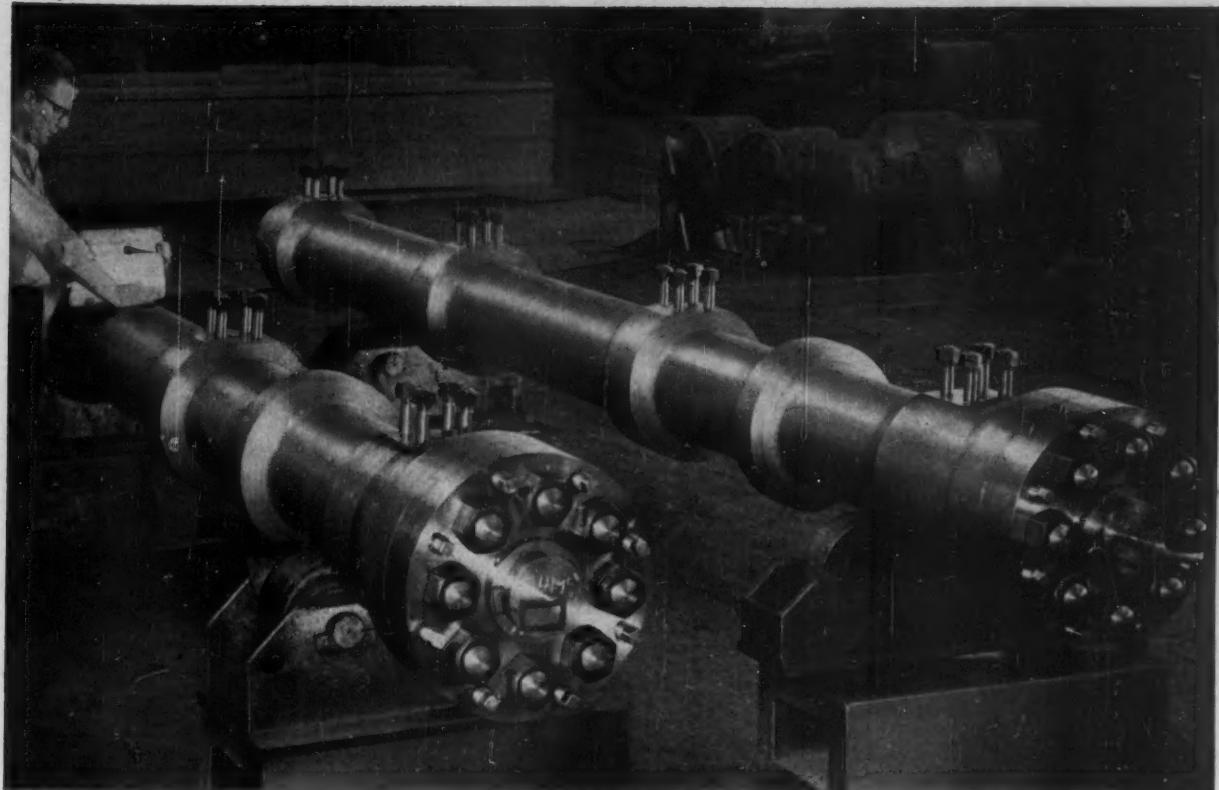
Type CNG Worthite Chemical Pump • SESC (Standard End Suction Centrifugal) • Type KEB Worthite Propeller Pump

Sizes ¾ to 6". Capacities to  
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General Service Pumps CNF, CNE, CNR.  
Capacities to 2600 gpm; heads to 550 ft.

Sizes 8 to 24". Capacities to  
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Making these slim storage bottles was one of the most interesting jobs we've had in some time. As pressure vessels go, the twins are fairly small, weighing only about four tons each. They are less than 20 ft long, and the OD of the large end does not exceed 22 in. But they had to be precision-built of alloy steel, for they are designed to withstand pressures in the neighborhood of 20,000 psi.

These vessels were not only forged but completely finish-machined in the Bethlehem shops. We're well set up for work of this nature, and customer specifications were met to the last detail. When the vessels left our hands, they were entirely ready for installation.

Bethlehem of course builds units that are many times larger than these, and some that are smaller. We forge and machine seamless vessels of practically every size and type. When you are planning new autoclaves, filters, reactors, converters, etc., we hope you'll call for our services. Bethlehem technicians will co-operate in every way, and the shops will follow through with an excellent production job.

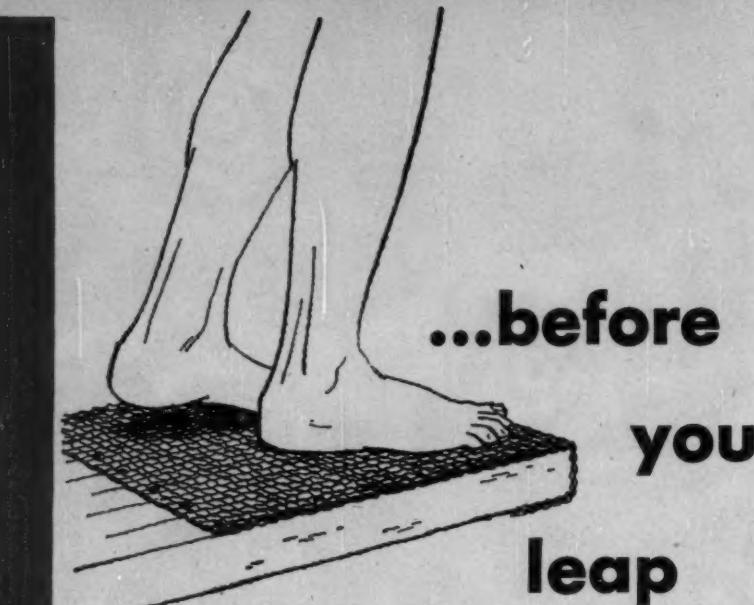
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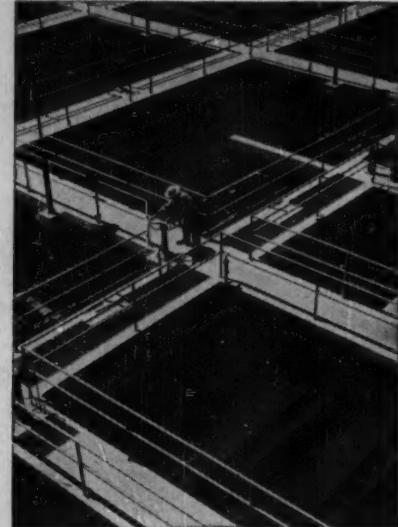
## Bethlehem Forged-Steel Pressure Vessels

Capsule Case History:



*A careful look by Kaiser Engineers  
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from traditional methods  
in developing plant designs that  
anticipate the client's needs for  
future expansion and improvements.*

*Numerous examples of this type of  
cost-saving engineering foresight  
are to be found in work performed  
by Kaiser Engineers in the  
broad fields of industrial design  
and construction.*



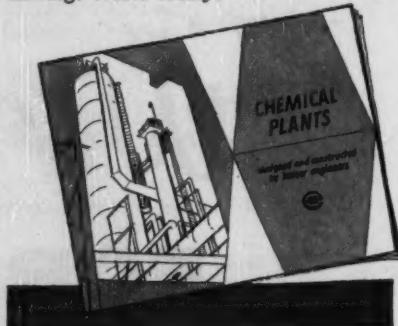
**A California City  
Expects To Grow**

so when Kaiser Engineers designed a new water treatment plant it was natural to consider future expansions. The present 21,000,000 gal/day plant has six flocculation tanks, six sedimentation tanks and twelve rapid sand filters.

**A Future Expansion**

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**A chemical processing brochure** (No. 101) is just out—yours for the asking. Write today.

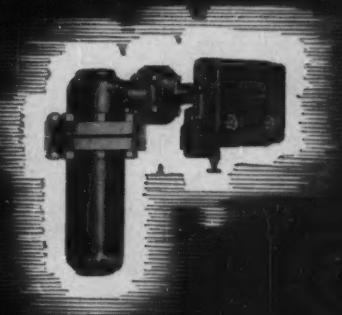


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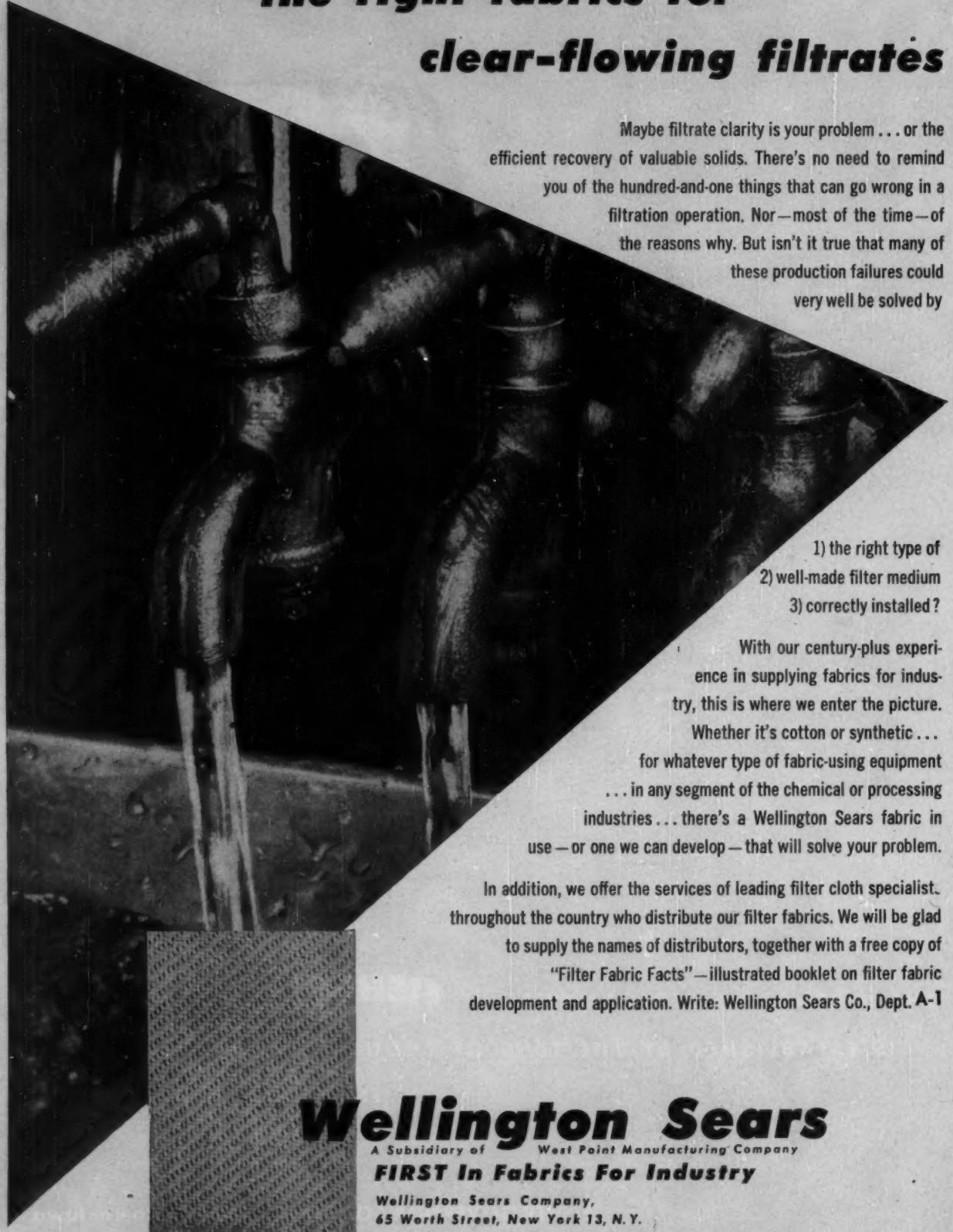


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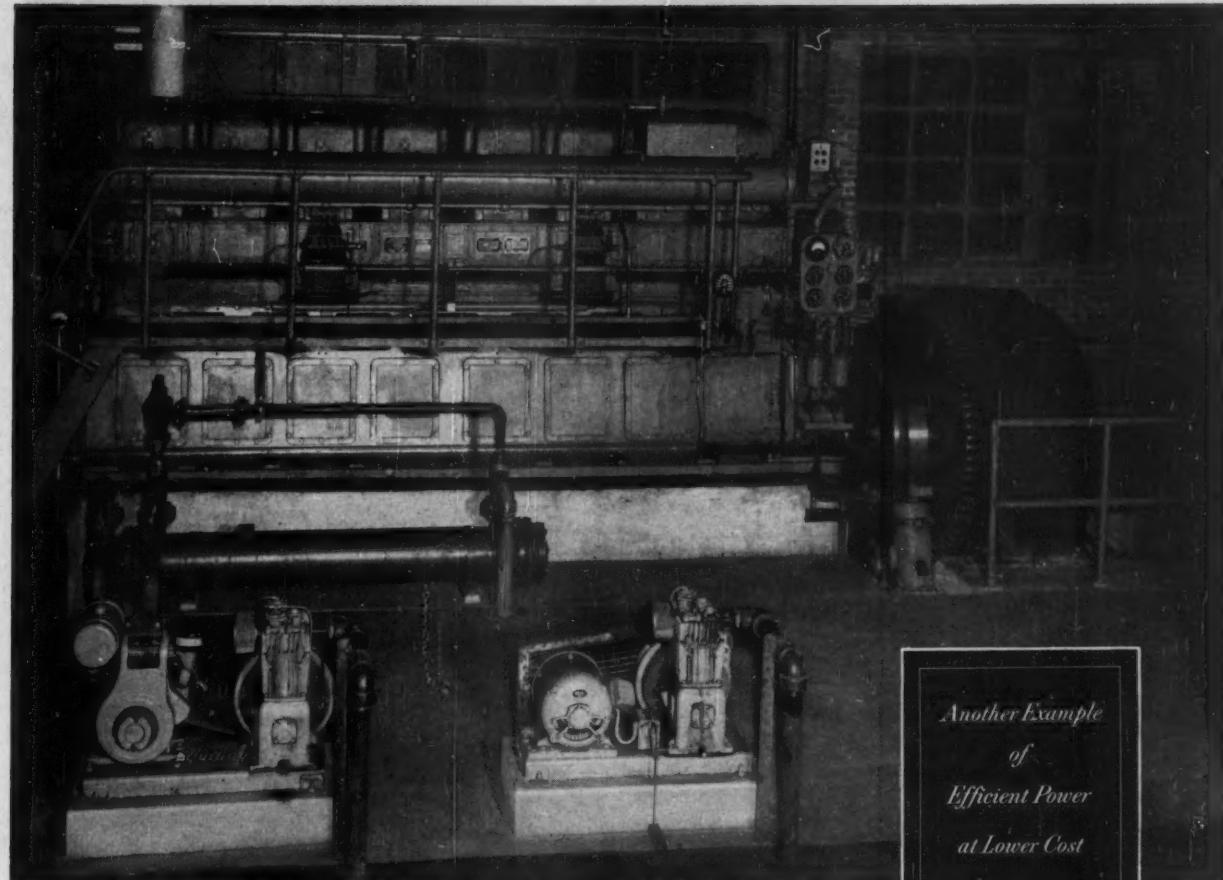
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Equipped with the latest engine advancements, this Cooper-Bessemer JS-8T at Breese, Illinois Light and Power, easily develops 1435 bhp at 450 rpm.

Another Example  
of  
Efficient Power  
at Lower Cost



## How "Packaged Power" Pays Breese a **BIG** Bonus

THE Cooper-Bessemer stationary generating engine in the Breese, Illinois Municipal Light and Power plant combines several unusual features that really pay off in greatly increased horsepower and unusually high thermal efficiency. To be exact, this 8-cylinder 13" x 16" supercharged JS engine develops 1435 bhp at 450 rpm—a rating out of the question only a few years ago, but now proved conservative.

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Respiratory Protection

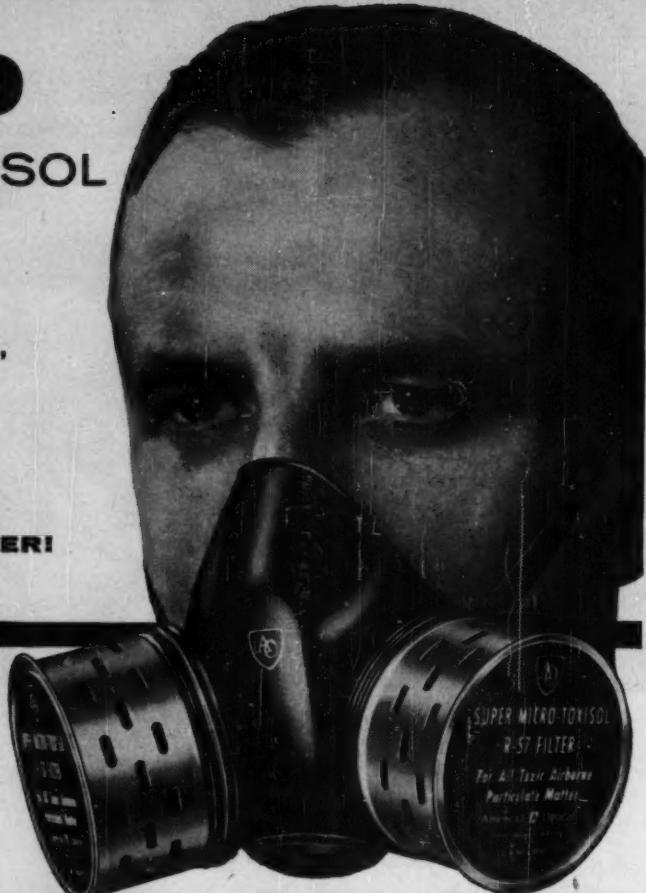
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micron in size!



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This respirator protects against all toxic air-borne particulate matter significantly more toxic than lead, including radioactive dusts, mists, fumes, and most types of bacteria. With this filter, protection against aerosols containing compounds of beryllium, selenium, arsenic, thallium, uranium, cadmium, radium, palladium, thorium, phosphorus, and chromium is assured.

AO's R5000 Respirator Series includes 9 interchangeable combinations which offer protection against many different hazards:

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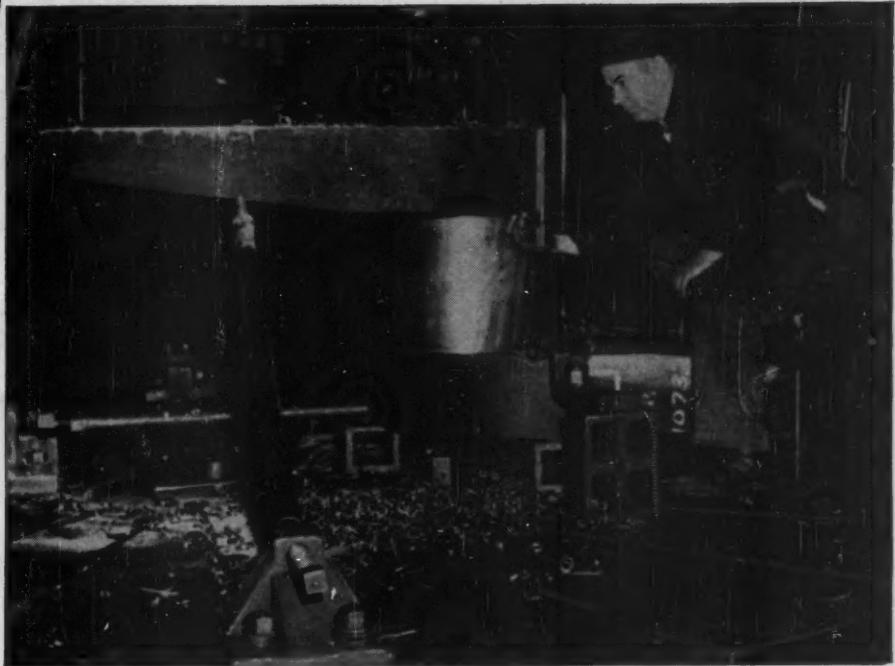
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SAFETY PRODUCTS DIVISION



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# The chips that talk...

To the native savage, whose tribe had no conception of a written language, the piece of wood on which the explorer scribbled a message became the wonderful "chip that talks."

The chips of metal that pour in silver drifts from the mighty machines in Sun Ship's Wetherill plant tell their stories, too. Those shown on the 14-foot boring mill tell part of the story of a fast, thorough repair job on ship-propulsion machinery. That job required lifting a 54-ton section of crankshaft from the ship to a 10 ft. x 50 ft. engine lathe, where

it was checked for trueness and the journals machined. The crankpins were machined in a huge crankshaft machine. The boring mill operation shown was the facing of the webs of a new section which replaced one of the damaged sections of the crankshaft.

That's the kind of story the versatile men and machines at Sun Ship have been writing for decades . . . in building special machinery of every type for the varied industries that are building a greater America.

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**SHIPBUILDING & DRY DOCK COMPANY**  
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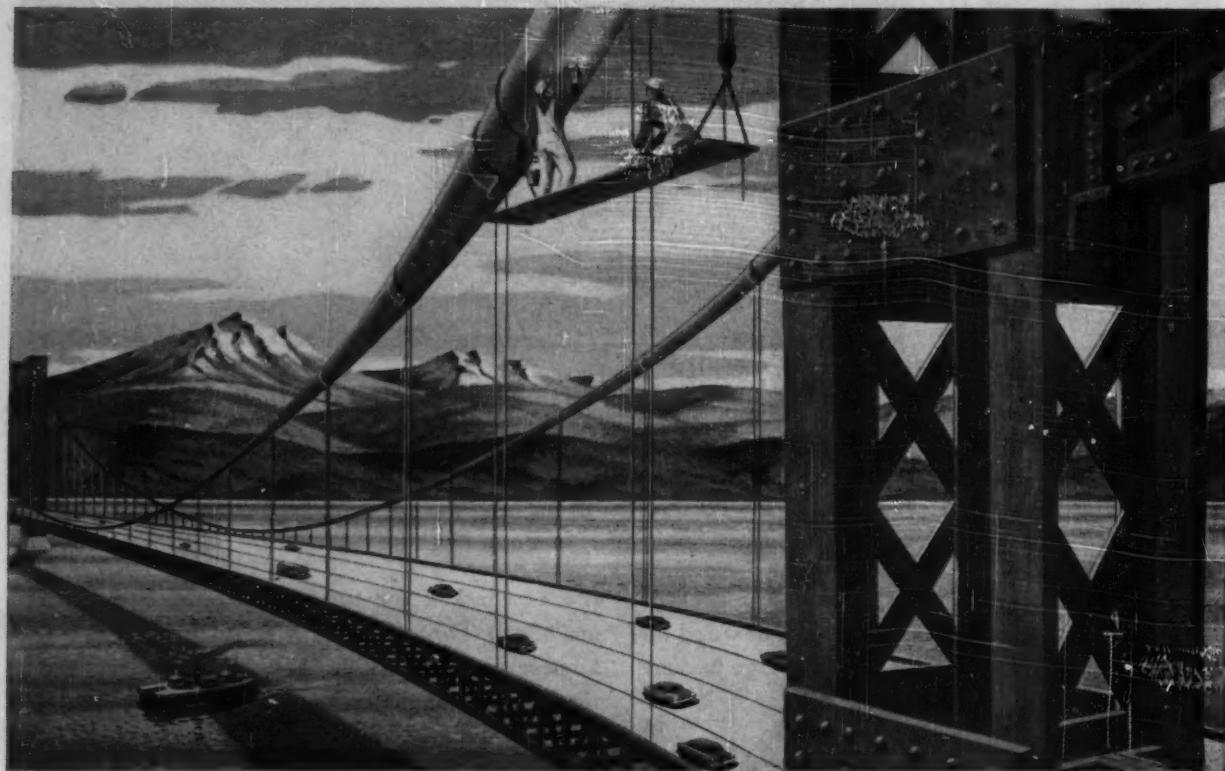
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# **EXON 471**

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Whatever your particular problem, you're  
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- . . . that "Karbate" brand impervious graphite — the original and most widely used brand—is manufactured exclusively by National Carbon Company?

**Don't wait until other materials fail — consider "Karbate" impervious graphite equipment right from the start when building a new plant or expanding present facilities. Our technical and engineering staffs are at your service.**

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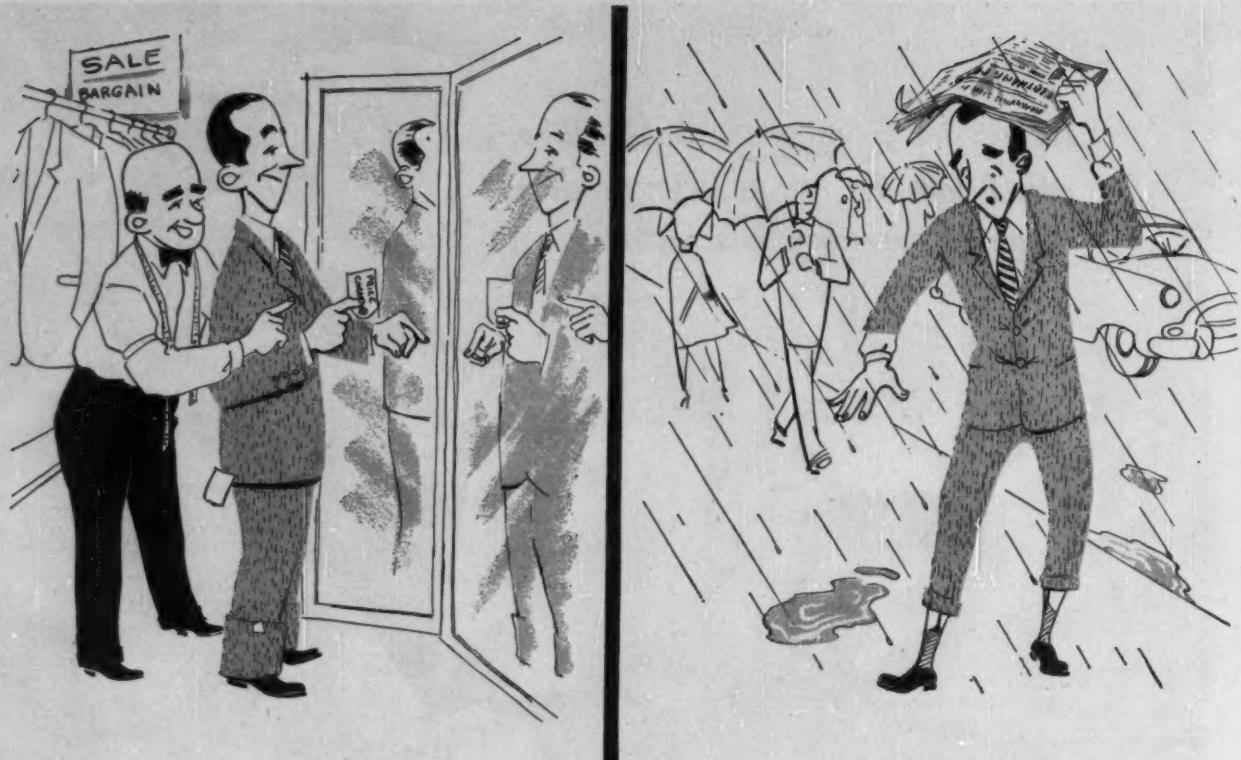
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## he was saving money until...

A brief shower washed out his presumed bargain—  
but he should have expected rain sometime.

*another record  
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A certain pharmaceutical manufacturer hasn't spent a penny for repair parts in more than three years since he purchased the first of the eight LaLabour Type G pumps he now operates.

Don't laugh—it can happen to you. Not with clothes, probably, but how about your chemical pumps?

"Bargain" pumps that let you down in an emergency—and every chemical plant expects emergencies—aren't very profitable. Nor is it a bargain when you have to buy the pump over and over again in replacement parts.

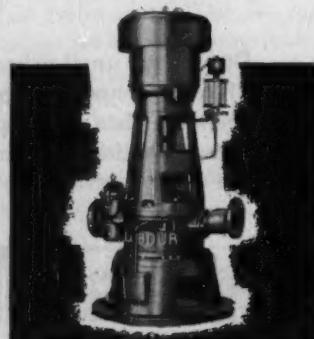
LaLabour Type G pumps are *genuine* bargains because they cost a great deal less in the long run. You spend less for replacement parts, less for labor to do the replacing, and you have less loss of production because your down time is low or non-existent.

That's no mere claim. It's a fact we can prove if you'll only give us the opportunity. Say when.

ORIGINAL MANUFACTURERS OF THE SELF-PRIMING CENTRIFUGAL PUMP

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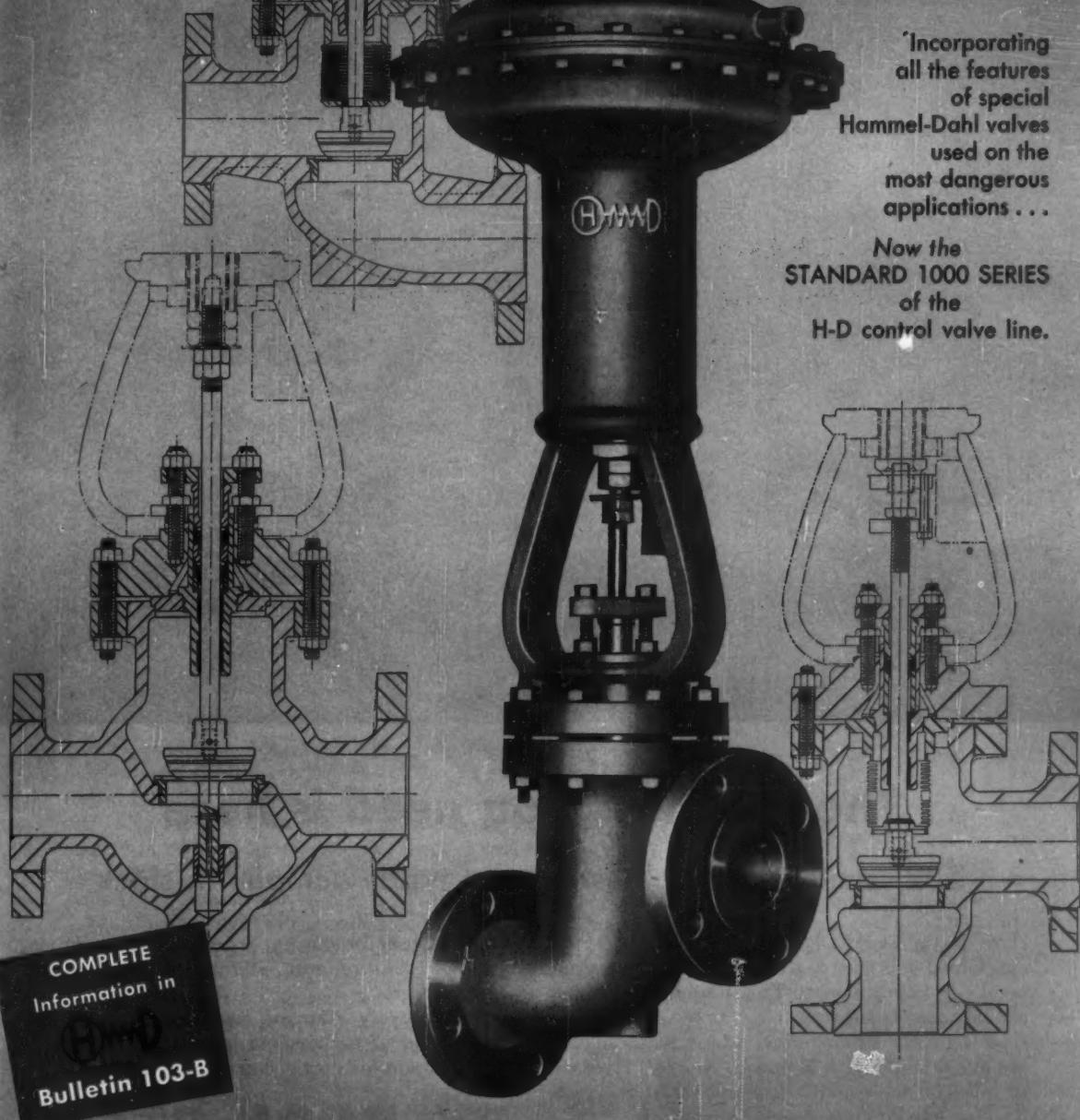
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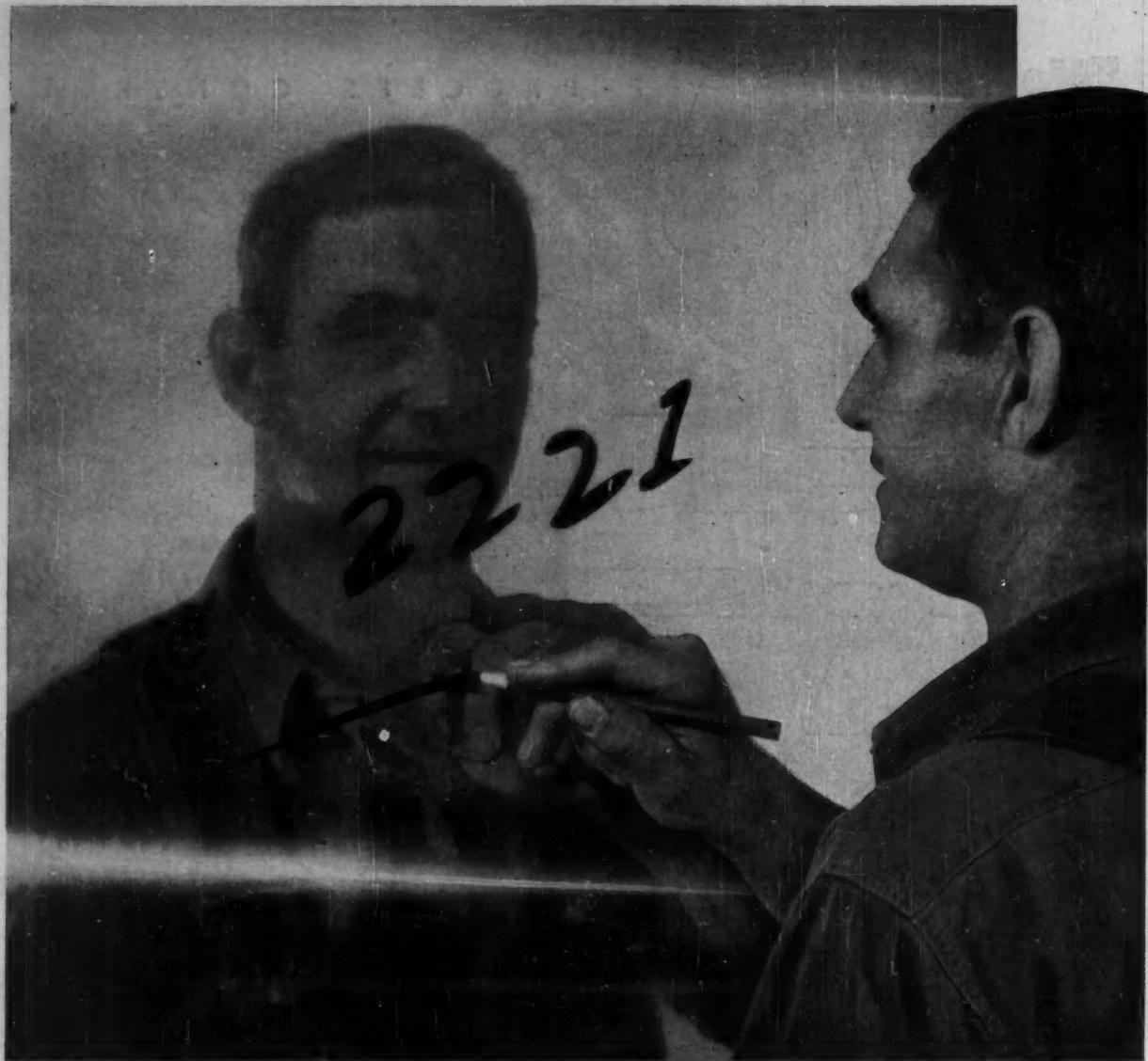


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"I BELIEVE the bosses must make the first move toward mutual understanding between estimators and management."

## Keep Cost Estimates Realistic

Though little explored, the subtle area of engineer-management relations has important effects on the quality of estimates.

### C. A. BUTLER, JR.

Many engineers think they would like to have more to say about running the business. Few realize that they do have an increasingly important say whenever they make a cost estimate. And the manner in which these estimates are made is one of the principal factors affecting the stature of the engineering profession in the eyes of management.

We all know that contractors live and die by their estimates. If they consistently estimate too low, they don't stay in business long. If their estimators play it safe and estimate too high, the contractor doesn't get any contracts. For these very reasons, contractors' estimators have always been respected as the best.

But estimating normally starts long before a contractor is brought in on a project. In making the basic decision to build a plant—or not to build it—cost estimates are playing an ever more important

role in every phase of the project. And they've got to be realistic.

### How Will Management React?

One very important, albeit intangible influence on the accuracy of cost estimates is the effect the estimate has on management—and vice versa. Take a look, for instance, at the reaction to an estimate that turns out to be too low.

Last year I was showing a banker through one of our plants and we had to cut the trip short so he could catch a plane. "I'd like to spend more time with you here," he said, "but we loaned a company about \$15 million to build a new plant and the damned fools have spent the money and need \$4 million more to get the plant done. If they don't know their business any better than that, I'm not so sure we want to loan them any more money."

If the banker thought that about the company, what do you suppose the president of that company thought about the estimating engineers who made the \$15 million estimate? (Continued on p. 172)

BERT BUTLER has been Director of Commercial Development for Diamond Alkali Co. since March 1954. For nine years prior to that he was Diamond's Director of Engineering—deluged by cost estimates.



**"No executive can do a smart job if he doesn't have reliable cost figures on proposed projects."**

**"It's important to understand why management insists on greater estimating accuracy than 10 or 15 years ago."**

### Who's to Blame?

But let's look at the other side of the picture for a minute.

We don't know whether the \$15 million was really an estimate or just a guess. Maybe the engineering department didn't have time to do a good job. Or maybe there were a lot of plan changes after the estimates was made.

In any case, somewhere along the line there must have been a lack of communication between management and the estimators so that management didn't know they had a bad estimate.

A lot depends on how management acts toward the estimate. If the estimator is sure he's going to be raked over the coals if actual costs exceed the estimate, his reaction is going to be to play it safe and make his estimate high. On the other hand, if he knows the bosses are all enthused about a project, he doesn't want to throw cold water on it with a high estimate even if the high estimate is realistic. He's likely to shade it on the low side.

This is particularly true if an earlier estimate has caused remarks from upstairs to the effect that the job couldn't possibly cost that much, that the engineers must be playing it safe. I don't believe any of us realizes how much psychological pressure affects our estimating work without our even knowing about it.

### Can You Be Perfect?

Recently, a man had to make an estimate for insurance purposes in about half an hour on repairing a boiler that had been wrecked by a furnace explosion. He came up with a figure of \$100,000. The complete repair job actually cost less than \$104,000.

Now of course a quicky that comes so close has a lot of luck in it. But I think there are some other factors that contributed to the accuracy of that estimate.

In the first place, the boiler was new and there were accurate cost records on each phase of its construction. Second, the estimate was only going to be used as a guide and nobody was going to holler if it wasn't quite correct. If it was low, the insurance company would pay the actual cost; if it was high, nobody was going to argue because the boiler had to be fixed anyway.

Also, the estimator knew exactly what the boiler would look like when it was rebuilt. This is extremely important. Sometimes we estimate one plant and by the time it's built it doesn't look much like the unit on which we based our estimate.

So here was a man with good cost data, a fixed design and no undue pressure that might cause him to shade the estimate up or down. Even though time was short, it was still possible to make a good estimate.

Now I know it's seldom possible to operate under such nearly ideal conditions. But when there's mutual respect between management and estimating engineers, together with proper understanding of each other's problems, it should be possible to remove undesirable pressures, freeze design specifications and have sufficient information for an accurate estimate to be made.

Those who work on a project must have faith in the estimates so that every attempt will be made to design and build the job for no more than the estimated cost.

### Maximum Accuracy Needed

I believe the bosses must make the

first move toward mutual understanding between estimators and management. And because of this responsibility, it's important to understand why management insists on greater estimating accuracy than they did 10 or 15 years ago.

An executive must look at an appropriation request not merely as an amount of money to be devoted to a stated project, but rather as a request for apportionment of the company's assets. The project must be viewed in the light of the company's aim to invest wisely the resources entrusted to it by stockholders. Projects must be chosen that will make the most money consistent with security and the future of the business.

Let's consider a project that overran the estimate but made a little money anyway. It still may have been a mistake to build it. If the actual cost had been known it might have been rejected in favor of a more attractive proposal. No executive can do a smart job without reliable cost figures on proposed projects.

Of course, this has always been true. But a few facts will show how the importance of estimates has increased in the last few years.

A chemical plant that cost \$10 million in 1940 would cost over \$22 million today. True, value of output has gone up, too, but investment costs have increased 125%, while value of product is up only 48% and manufacturing costs have increased 54%.

Profit before federal income tax would be nearly the same in dollars. But it takes 225% as much money to build the plant and supply working capital. With increased taxes the actual profit is 32% less than in 1940. The decrease in return on operating investment is staggering—less than 4% today as against nearly 13% in 1940.

*"It's up to the engineer to point out, when presenting the estimate, any probable inaccuracy due to lack of time."*

*"Overestimating has hazards and it takes a lot of moral courage to keep from making estimates too high."*



In an alarming manner, this shows what has happened. Back in 1940 you could make a large return on properly selected investments. If a plant made little or no profit, the stability of the company was not too adversely affected.

But under present conditions there are only a few projects that make enough to attract investment capital. If an ill-advised decision is made which results in a plant being built that produces low return or loss, it's nearly impossible to offset it by building another plant that will make a handsome return. Management just can't afford ill-advised decisions.

The two factors chiefly responsible for decreased returns are higher taxes and higher construction costs. Analyzing the effect of each we find that increased construction costs make today's return on investment 54% less than in 1940; increased taxes account for only a 38% reduction in the return.

I wonder if engineers and estimators might possibly be in even more hot water about such things as construction overruns if the bosses weren't so busy growling about high taxes that they didn't remember that increased investment costs are doing a lot more damage to the return on their investment than increased income taxes have done.

#### The Engineer's Responsibility

To be of greatest use, estimates cannot be too high or too low. In fact, the only way to make an estimate on which it's really safe to make a major decision is after complete engineering design, including preparation of detailed drawings. With proper cost data from previous jobs and complete bills of materials, a firm estimate can then be made.

This means the boss must bear some of the blame for poor estimating when an engineer is told to make an estimate without the opportunity to complete the engineering.

Of course there are many times when estimates are demanded based on extremely meager information. And in such cases the engineer is not relieved entirely of responsibility. It's up to him to point out, when presenting the estimate, any probable inaccuracy due to lack of time.

It is possible, though obviously hard, to determine the effect of incomplete design and missing data on the probable accuracy of estimates. And if a frank statement of this probable error is presented, the boss can make his decision with full knowledge of the chances he's taking.

For instance, if a project is presented as one that probably will cost \$4 million but due to lack of information could quite easily cost as much as \$5 million, no one has the right to complain very bitterly if the actual cost is 25% more than the authorized \$4 million.

But if an engineer is told to get an estimate in by next Friday and simply sends it in cold, he really has little right to use short time as an alibi if an overrun does occur. If in an extreme case the proposition is presented with the possibility that it may run over by 25-100%, management is very likely to come back with orders that the necessary work be done to make a more accurate estimate possible.

#### Don't Be Afraid

It may be that some estimators hate to admit, even under adverse conditions, that their estimates aren't accurate. The only reason I can see for the fact that so many estimates are submitted as "good" when the es-

timator knows they are based on insufficient data is simple neglect to include a statement of possible maximum cost in addition to the best estimate.

Remember, the spread between maximum and expected figures should be the most useful way to impress on the dollar-conscious executive the chances he's taking.

Complete frankness by the estimator will also tend to minimize the chances of management trying to make mental corrections based on past jobs, or, worse yet, on hunches. In some firms executives are known to always add or subtract from estimates on an arbitrary basis and the estimators try to allow for this. In such cases the whole process of making an interpretive estimate degenerates into a sort of guessing contest and complete confusion.

#### Overestimating Has Hazards

The best way for an estimator to keep out of trouble is to make sure his estimates are high enough. But it takes a lot of moral courage to keep from making them too high.

Estimates must serve as a guide in deciding which of several possible projects should be chosen. So an estimate that's too high might easily cause the boss to turn down an attractive proposal. Under present economic conditions, there are so few really good projects that it's a serious error to reject one for any reason.

Overestimating is also very likely to lead to waste in design and perhaps in construction, too. On a job where there is apparently plenty of money, it's just human nature not to watch costs as closely as on one where everyone has to be on his toes to get the project done within the allotted amount. (Continued on p. 174)



*"Overestimating, though not quite as great a sin as underestimating, is still something to be avoided."*

*"Good though they may be, there must be a definite responsibility for meeting the estimates."*

And waste often starts on the drafting board because without the necessity of keeping within a tight estimate, the project can be overdesigned and too many frills included. Money wasted in construction is seldom recoverable. It becomes a burden on earnings until the plant has been abandoned or amortized. On the other hand, if waste is discovered in operation, there's usually some way to reduce or eliminate it. For this reason, the importance of guarding against waste in design and construction is greater than the importance of guarding against waste in operation.

It must be concluded, then, that overestimating, though not quite as great a sin as underestimating, is still something to be avoided.

There is great temptation to overestimate because criticism seldom materializes. A high estimate usually results in a job not being built, so no one ever has proof that the estimate really was substantially high. So, though overestimating may be comparatively safe practice for the estimator, it's not good for the company whose management is making decisions based on those estimates.

#### Fix Responsibility

Of course, it's management's duty to supply estimators with enough accurate information from cost records on previous jobs or other available sources. It's then the engineer's duty to present estimates which are as accurate as possible, but which are perfectly frank on any short-comings. When this has been done, there will be a much increased respect for estimates.

But good though they may be, there must be a definite responsibility for meeting the estimates.

In a job done under desirable

conditions, fixing responsibility is usually not too hard. A preliminary estimate usually results in authorization for engineering only. The designer is encouraged to be as economical as possible by the knowledge that if he's not, the project when finally estimated will cost so much it can't be built. The final estimate in this case should be made by the people responsible for construction.

And in this connection engineers shouldn't feel too badly if they spend months completely engineering a job that is not built. Their work is carrying the job to a point where it can be estimated accurately is not at all wasted. It has resulted in keeping the company out of an unattractive project.

But what about the rush job that won't allow complete engineering before authorization? Well actually, it's not really much harder to fix the responsibility.

At the early stage, the design engineer and the construction engineer have a joint responsibility to meet the estimate. In order to fix the final responsibility it is necessary, even though the project is already authorized, to make a complete and detailed firm estimate as soon as drawings and bills of materials are complete.

If this estimate is higher than the authorized amount, the increase is due to things that happened during the design, although not always the fault of the design engineer. The construction engineer should then expect to build the job for the amount in the firm estimate.

When a job is authorized with really meager information, an approximate estimate should be made as soon as the general principles of design are determined—flow sheets completed, principal equipment sized and priced. Such an estimate is a pretty good indi-

cation of whether the amount authorized is adequate.

#### What's Ahead?

It's unfortunate that during recent years, when the importance of estimating has been increasing, we've been operating first under war conditions, then under postwar shortages and most recently under conditions of preparation for defense.

Too often this has resulted in jobs being authorized and built in a rush with too little attention being paid to costs. This may be one reason why so few, particularly in the newer generation of engineers, have realized the growing importance of accurate estimates in making executive decisions.

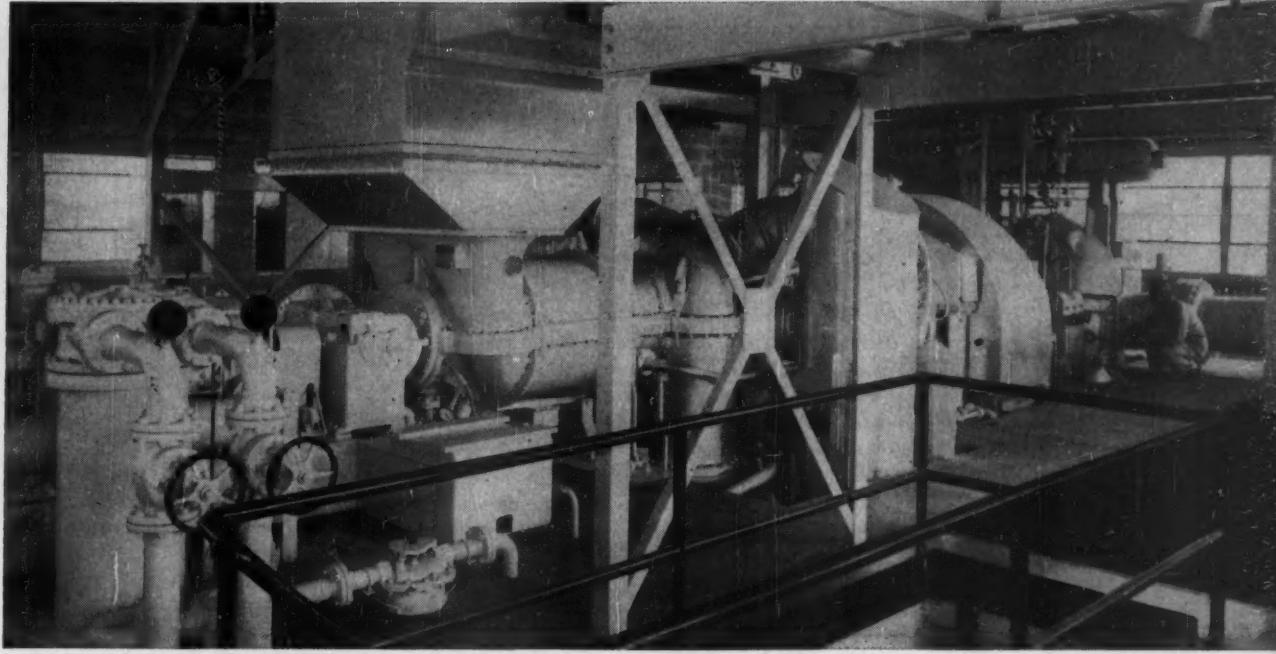
Is this a permanent situation?

It's quite likely that prices will rise to compensate for greater investment costs. But that won't happen until existing plants wear out or until depreciation is allowed to be based on replacement costs rather than actual costs.

Because wage rates in the building trades must be in line with what can be earned on production lines, investment costs will continue to rise with respect to operating costs.

Operating costs, in turn, can be lowered by advances in technology. But it's almost axiomatic that improved technology which tends to keep operating costs from rising rapidly will in itself increase investment costs.

Finally, the bulk of national debt probably will be increased by the necessity of military preparedness and by the increased services the public demands of government. It is quite unlikely, therefore, that we will ever again reach the era of profit levels in heavy industry that will permit us to afford a plant that doesn't make an adequate profit.



Gas turbine built by General Electric drives a pipeline compressor.

## Gas Turbines for Process Use—I

There are few gas turbines in process plants today but they should eventually find wide use by incorporation in process cycles. Some of these cycles will be detailed in Part II, in an early issue.

**BENJAMIN MILLER**

Eight years ago a *Chemical Engineering Report* on progress in development of gas turbines pointed out that the gas turbine can be designed to produce power, steam and compressed air, with the total output divided among these three in any desired proportions. It might have been expected that so versatile a device would by now have found many uses in the process industries, especially since there were at that time more than 30 units supplying compressed air for catalyst regeneration in Houdry fixed bed oil cracking installations. But the process industries have not yet adopted the gas turbine to any notable extent, and the Houdry process has been largely superseded by other catalytic cracking processes which do not employ gas turbines. Actually, there are fewer gas turbines operating in process industries today than there were in 1946.

Considering its failure to have won by now an important place in the process industries, it may seem unrealistic to repeat that chemical engi-

neers will do well to become familiar with the gas turbine. Granted that power and steam and compressed air are only utilities, and are not the primary concern of the chemical engineer; granted that the well-known ways of supplying these utilities are reliable and have in the past been acceptable as to cost; granted in short that the industries served by chemical engineers have done very well up to now without the gas turbine, it still remains possible that in the future they can do even better by using the gas turbine in appropriate situations, particularly in view of the new developments discussed below. Chemical engineers familiar with the characteristics of the gas turbine will look for, and find, opportunities to make effective use of it. The potential economies will become increasing attractive as competition becomes more intense.

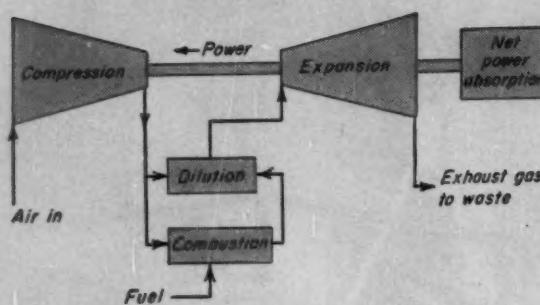
### Gas Turbine Process

In the broad sense a gas turbine is a spinning device which abstracts mechanical energy from an expanding

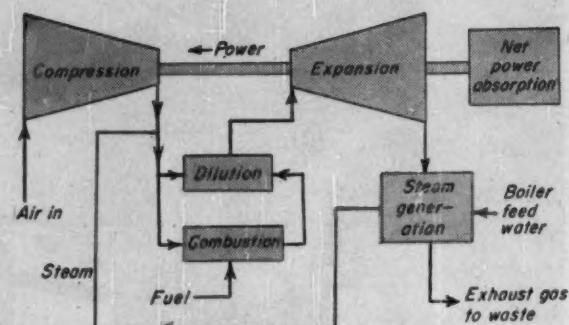
gas. For the present purpose, however, a gas turbine—more precisely, a combustion gas turbine—is a combination of apparatus elements with which to carry out a combustion gas turbine process. This is a continuous flow process in which air is compressed, fuel is contacted with the stream of compressed air and combustion takes place, the hot combustion products are expanded, and mechanical energy abstracted from the expanding hot combustion products is fed back to compress the air. This narrow definition excludes many devices which are frequently classified as gas turbines, such as turbines which expand the exhaust gas from reciprocating engines, free-piston gas turbines, closed-cycle gas turbines, and various other compressed-gas expanders.

Because of apparatus limitations the combustion gas turbine process cannot be carried out in its simplest form. Instead, one or more additional steps must be included, so that many different combustion gas turbine processes have been proposed.

## GAS TURBINES . . .



SIMPLEST practical gas turbine has air dilution—(Fig. 1)



STEAM dilution improves gas turbine process—(Fig. 2)

The maximum safe inlet temperature for the combustion products expander has probably been the most serious apparatus limitation. Combustion with air of all common fuels yields products which are, when first formed, at temperatures much higher than the highest temperature at which any known material has the mechanical properties needed in a turbine blade. No way has yet been found to keep the temperature of the turbine blades from approaching the temperature of the gases passing over them. So, it is necessary to include in the process at least one step which serves to cool the combustion products before they enter the expander.

The first practical use of the gas turbine was in the Velox boiler steam generation process. Here the objective is to decrease the size of the boiler by carrying out the combustion and transfer of heat from the combustion products to water, under pressure of a few atmospheres. The heat transfer step cools the combustion products to a temperature readily tolerated by the expander. In the first Velox boiler plants the power required for compression exceeded the power available from the expansion; an electric motor made up the deficiency. Later installations operate with a small surplus of power from the expansion which is absorbed by an electric generator.

Next practical application was in the Houdry fixed-bed oil cracking process where the fuel is coke, deposited on the cracking catalyst, and the combustion regenerates the catalyst. To avoid damage to the catalyst, its maximum temperature is kept below 1,100 F. by circulating a molten salt mixture through tubes passing through the catalyst bed. The temperature of the

molten salt is maintained near 800 F., which makes the temperature of the combustion products leaving the catalyst case about 825 F. Thus, maximum safe inlet temperature of the expander presents no problem. Here again the cooling of the combustion products is required for a reason other than the protection of the expander. The heat absorbed by the molten salt is removed outside of the catalyst case by heat transfer to boiling water. Again, most of the heat of combustion is used to generate steam. A small surplus of power is absorbed by an electric generator.

More commonly the combustion products are cooled by mixing them with a relatively cold fluid, usually air, so that substantially all of the heat of combustion remains in the stream which enters the expander. The most widely used gas turbine processes thus include the steps of compression, combustion, dilution, expansion and power feed-back, as shown in Fig. 1. This is the flow diagram for what is probably the simplest practical gas turbine process.

### Simple Process Arithmetic

Gas turbine process calculations are simple and straightforward; they require neither data nor methods with which chemical engineers are not familiar. The fluids and conditions involved are such that the perfect gas laws apply with sufficient accuracy. The entropies and heat contents (enthalpies) required may be obtained from standard compilations, such as National Bureau of Standards Circular C-461, on the assumption that air and other mixtures used in the process are perfect solutions. Air may be considered a mixture of 21 mole %

oxygen and 79 mole % nitrogen; the errors due to neglecting argon and water vapor are at least partially compensating, and the net error due to this approximation is of the same order as the uncertainty due to normal variation in atmospheric humidity.

To illustrate the calculation procedure it is convenient to consider a hypothetical situation in which the process is carried out in equipment which has no losses. Assume, for example, that the temperature at the compressor inlet is 80 F., the compressor pressure ratio is 9.0, the fuel is methane, and the turbine inlet temperature is 1,520 F.; this is about as high a turbine inlet temperature as can be employed with the materials of construction now available. An air flow rate of 10,000 moles per hr., which is about 80 lb. per sec., will be used.

The calculated performance is summarized in the first column of the accompanying table (p. 179) which shows fuel rate, combustion air rate, and quantity per hr. of diluted combustion products at 1,520 F. supplied to the turbine. Both compression and expansion are taken as isentropic, with the resulting temperatures at compressor and turbine outlet, and the turbine power output, based on that assumption. Of the total power produced, 12,830 hp. recycles to the compressor, leaving a net power output of 13,940 hp. for absorption by the load. The fuel requirement is thus 5,708 Btu. (lower heating value) per hp.-hr. and the thermal efficiency based on the lower heating value is 44.6%.

Because of apparatus imperfections the fuel and air requirements of an actual plant carrying out such a process would be about twice as great as those

just calculated. Allowances for such imperfections can be made with accuracy only on the basis of actual test results on equipment similar to that proposed to be used, but fair estimates can be made by using efficiencies and loss factors which experience has shown to be reasonable. Thus, for estimating purposes when data are lacking, one may take 85% for the isentropic efficiency of compression and 98% for the combustion efficiency. Turbine efficiency will range from 85 to 90%, with the lower figure applicable to designs suitable for the highest inlet temperature.

There is an over-all pressure drop of 2 to 5% in the combustion and mixing steps, with the higher figure applicable for the highest turbine inlet temperature. The higher the average turbine inlet temperature, the less can be the tolerance for temperature variations, so that more intense turbulence with consequent higher pressure drop must be provided.

Finally, an allowance of 1 to 3% of the turbine enthalpy drop is needed to take care of bearing friction, operation of auxiliary equipment such as lubricating oil and cooling water pumps, air extracted from the main flow for turbine cooling, and miscellaneous heat losses. Again, the higher figure is applicable for the highest turbine inlet temperature.

The example summarized in the first column of the table can be calculated with the allowances just given. The results appear in the second column where it will be noted that the power consumption of the compressor and its outlet temperature both increase materially due to the non-isentropic compression. Since the turbine inlet temperature remains the same, there is a slight decrease in fuel and combustion air rate. With pressure drop in combustion and mixing assumed to be 5%, the expansion takes place through a pressure ratio of 8.55, at 85% isentropic efficiency, yielding the indicated total power output and exhaust temperature. Since losses take 3% of the turbine enthalpy drop, the total available power is reduced to 21,660 hp., of which 15,090 hp. recycles to the compressor, and 6,570 hp. is available for absorption by the load. Apparatus shortcomings thus reduce thermal efficiency.

from the theoretical 44.6% for the ideal case in Column (1) to 22.2% as indicated in Column (2).

#### Compressor Inlet Temperature

The power absorbed in compression is roughly proportional to the absolute temperature at the compressor inlet. Thus in the example just given, if the compressor inlet temperature is 35 F. instead of 80 F. the compression takes only 13,860 hp. This reduction of 1,230 hp. in compression requirement is the principal reason for an increase in net power output to 7,880 hp., or nearly 20%. There is an increase of about 9% in fuel consumption because the temperature of the air at the end of compression is only 534 F., so that the thermal efficiency is increased from 22.2% to 24.5%. On the other hand, increasing compressor inlet temperature sharply reduces both the capability and thermal efficiency of the simple gas turbine process.

In considering the use of a gas turbine, therefore, it is essential to give proper weight to its behavior under the various atmospheric conditions which may be expected. In comparing the capabilities and efficiencies of gas turbine plants or processes, the same compressor inlet temperatures must be used. Where high ambient temperatures are to be expected, intake air coolers on gas turbines may be necessary for economy. Where there is considerable spread between wet- and dry-bulb temperatures—if water is available—cooling of intake air by spraying water into it is recommended.

#### Turbine Inlet Temperature

Nominal maximum turbine inlet temperatures for gas turbines now be-

ing offered to burn natural gas range from 1,350 F. to 1,450 F. Everything else being equal, an increase in turbine inlet temperature from 1,350 F. to 1,450 F. yields a substantial increase in thermal efficiency; however, machines designed for 1,350 F. have substantially the same thermal efficiency as those designed for 1,450 F. In both types the actual maximum temperature of the rotating blades is about 1,300 F. The higher turbine efficiency obtainable by designing for relatively small temperature drop from inlet to the first rotating blades, and the lesser pressure drop required in the mixing step for the lower average mix temperature, substantially balance the thermodynamic advantage of higher inlet temperature. The air requirement, however, is much less with the higher turbine inlet temperature, which may be important in some applications.

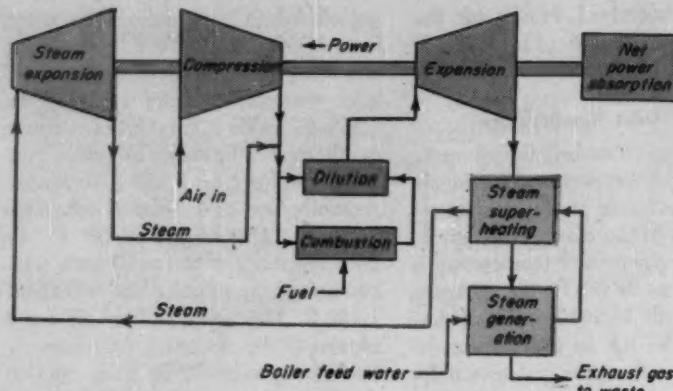
Thermal efficiency of a gas turbine could be increased substantially if higher turbine inlet temperatures could be employed without increasing pressure drops, decreasing turbine efficiency, adding to friction and heat losses, or requiring more auxiliary power. There is no reason to believe that materials of construction having the necessary properties will not eventually become available. However, despite much work by many men there has been no appreciable progress along these lines in recent years. This suggests that alloys of the types now in use have already been developed to maximum performance, and that something radically different must be discovered to make substantially higher turbine inlet temperatures possible. In view of the time required to prove



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In the 30's gas pipeline work aroused his interest in gas turbines. In 1950 his studies led to one of the first gas turbine pipeline compression installations. The steam dilution and other processes described here stem from his work as a consultant for the Chemical Foundation.

## GAS TURBINES . . .



EFFICIENCY increases when dilution steam is generated at high pressures—(Fig. 3)

the reliability of any new material after it has been put to use, it may be expected that the range 1,350 F. to perhaps 1,550 F. will continue to be the maximum for many years to come.

### Regeneration, Intercooling, Reheat

Only 3 to 5% of the lower heating value of the fuel actually becomes unavailable in the simple gas turbine process, while 70 to 80% remains in the turbine exhaust as sensible heat. The way to improve the thermal efficiency is obviously to reclaim energy from the exhaust, either by converting part of it to mechanical energy or by utilizing some or all of it as heat to accomplish some purpose which would otherwise require the consumption of additional fuel. Various elaborations of the simple gas turbine process may be used to reduce the fraction of the heating value of the fuel which is rejected with the exhaust to the atmosphere.

There are several classical gas turbine processes which convert into mechanical energy part of the heat which the simple process rejects with the exhaust. These include the steps of regeneration, intercooling, and reheat, singly or in combination. In the regenerative process heat is transferred from the exhaust to the compressed air to be used for combustion and dilution. In the intercooled process the compression is divided into two or more stages; the air is cooled at intermediate pressure, then compressed to maximum pressure. In the reheat process the expansion is divided into two or more stages; part

of the exhaust at intermediate pressure is used to burn an increment of fuel. The products of this second combustion are mixed with the remainder of the exhaust at intermediate pressure, and the mixture is then expanded further.

Regeneration, intercooling and reheat make possible a reduction in fuel consumption of up to one-third, but require much greater investment per horsepower. As the thermal efficiency is still much below what can be attained with reciprocating engines, the use of classical gas turbine processes which include one or more of these additional steps is justified in only a few situations.

### Exhaust Heat Recovery

Where large quantities of process heat at temperatures up to about 1,000 F. are required, the exhaust from the simple gas turbine process may be used effectively. Simplest application is direct-contact drying of material not damaged by hot air or combustion products. If the exhaust temperature is too high, tempering air can be added; an increment of fuel can be burned in the exhaust to raise its temperature if necessary. Sensitive material may be heated indirectly.

Passing the exhaust through a conventional waste heat boiler or water heater to produce steam or hot water is frequently proposed. In one outstanding installation gas turbine exhaust heats boiler feedwater, replacing steam which was formerly extracted from steam turbines. The steam tur-

bines, their condensers, and the generators they drive all had spare capacity, while the boilers did not. In this way the steam plant now generates more power. In effect, a large part of the heat in the gas turbine exhaust is thus used to generate power.

Gas turbine exhaust can also be used as preheated combustion "air" in a boiler furnace or other fuel-fired furnace, provided the lesser oxygen content is acceptable, and if the furnace is not equipped with air pre-heaters.

Secondary utilization of heat taken from the gas turbine exhaust is most likely to be advantageous in situations where an existing power plant is inadequate in some respect. Whenever a processing plant generates its own power and needs more than present facilities can provide, consideration of the gas turbine is indicated.

### Steam Addition Process

Steam can be used instead of air to dilute combustion products in the gas turbine process. It has the advantage over air that it can be provided under pressure with the expenditure of very little mechanical energy, simply by injecting water into the combustion products. The gas turbine process with water injection is not attractive, however, because the latent heat of evaporation increases the fuel consumption so greatly. As noted above, it takes 1.5 hp-hr. to compress a mole of air at 80 F. to 9.0 atm. at 85% isentropic efficiency, and to a final temperature of 621 F. To convert a mole of liquid water at 80 F. to steam at 9.0 atm. and 621 F. takes about 23,000 Btu., which is too high a price to pay for 1.5 hp-hr. At the lower pressures more commonly used in gas turbine processes, the fuel cost of water injection is even higher.

However, if the latent heat could be supplied without increasing the fuel consumption, the thermal efficiency could be increased by using steam for dilution. This can be accomplished to a limited extent by generating the steam in a waste heat boiler which recovers heat from the exhaust, as shown in Fig. 2.

As an illustration, take the process outlined in Column (2) in the tabulation (p. 179), modified only by the addition of 2,000 moles per hr. of

steam saturated at 350 F. This is used as a diluent in addition to the 10,000 moles of air. The same losses are involved, and the same turbine inlet temperature. The fuel and combustion air requirements, shown in Column (3), increase because of the need for superheating the steam. In addition to the 5% pressure drop in the combustion and mixing, there is an additional 3% pressure drop assumed in the generation of the steam by heat transfer with the exhaust gases. Hence, expansion takes place through a pressure ratio of 8.28. Auxiliaries and various losses combine to reduce the total available power output to 26,000 hp., of which 15,090 hp. is required by the compressor, while there is a net output of 10,910 hp. for the load. Thermal efficiency is thus increased to 27.9%, compared to 22.2% for Case (2), but at the expense of 72 gpm. of water which must be supplied.

Comparing this example with the similar example of the simple process in Case (2), it is to be noted that the steam addition process produces 66% more net power with the same compression capacity, but requires 20% more expansion capacity and the additional steps of generating steam and adding it to the air. The fuel requirement is reduced by 20%, but the water used to generate the steam must be provided.

#### High Efficiency Steam Addition

The generation of the steam in the example just given reduces the exhaust temperature from 848 F. to 411 F., with water entering at 80 F. By increasing the heat transfer effectiveness the exhaust temperature can be further reduced, more steam can be generated, and the thermal efficiency can be further increased. However, the equipment cost will be increased also. Just how much steam to generate must be determined in each case.

Higher thermal efficiency can also be attained by combining steam addition with regeneration, intercooling, and reheat, using one, two, or all three.

Another way to increase thermal efficiency is to increase the enthalpy of the steam by generating under higher pressure, or superheating, or both, thereby reducing the quantity

of fuel needed to heat the steam to the final mixture temperature.

In some situations it will be most economical to generate the steam under high pressure, superheat it, and then expand through a steam turbine to the pressure of the air at the end of the compression step, as shown by Fig. 3. Thus the 2,000 moles of steam per hour of the previous example could have been supplied at 900 psig. and 600 F. Expansion through a moderately efficient steam turbine to 120 psig. would produce 1,460 hp. net, making the total output 12,370 hp. The thermal efficiency would thereby be increased to 31.7% based on the lower heating value.

The exhaust may be passed through two waste heat boilers in series, with the second boiler generating steam at the air compression discharge pressure and the first boiler generating at a convenient higher pressure. The steam from the first boiler would then be expanded through a steam turbine to the pressure of the second boiler, being mixed with the steam from the

second boiler for addition to the compressed air.

#### Using Two Heat Sources

Steam used as diluent in the gas turbine process may be generated with heat from some other source; if it is, the gas turbine process is using two heat sources. The primary heat source is the fuel whose combustion products are diluted to a tolerable temperature and then pass through the expander; the secondary heat source may be anything which can supply heat at a temperature above the saturation temperature of water under the pressure at the inlet to the combustion products expander. Thus any stream of hot material which can supply heat to a waste heat boiler is potentially a secondary heat source for a gas turbine. Heat in products of high-temperature chemical reactions, heat from nuclear reactions, and heat in products from high-temperature distillation can all be used to generate steam to dilute combustion products.

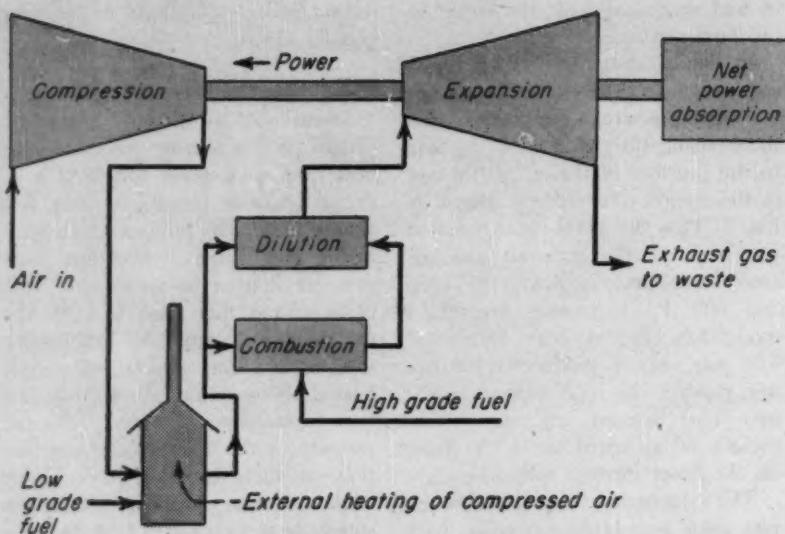
Steam for dilution can also be gen-

#### How Three Gas Turbine Processes Compare

Ideal process is assumed perfect, without losses; practical conventional process based on performance of equipment which can be built now; normal losses; steam dilution process is practical design with steam from exhaust-heated boiler generated at 350 F.

|                                    | Conventional Processes |           | Steam Dilution, Practical |
|------------------------------------|------------------------|-----------|---------------------------|
|                                    | Ideal                  | Practical |                           |
| Air flow, moles/hr.                | 10,000                 | 10,000    | 10,000                    |
| Compressor inlet temp., °F.        | 80                     | 80        | 80                        |
| Compressor pressure ratio          | 9.0                    | 9.0       | 9.0                       |
| Compressor outlet temp., °F.       | 542                    | 621       | 621                       |
| Compressor power, hp.              | 12,830                 | 15,090    | 15,090                    |
| Fuel flow, moles/hr.               | 231                    | 217       | 288                       |
| Combustion air flow, moles/hr.     | 2,200                  | 2,067     | 2,740                     |
| Steam diluent at 350 F., moles/hr. |                        |           | 2,000                     |
| Steam to combustion, moles/hr.     |                        |           | 548                       |
| Dilution air flow, moles/hr.       | 7,800                  | 7,933     | 7,260                     |
| Turbine inlet temp., °F.           | 1,520                  | 1,520     | 1,520                     |
| Total gas to turbine, moles/hr.    | 10,231                 | 10,217    | 12,288                    |
| Turbine pressure ratio             | 9.0                    | 8.55      | 8.28                      |
| Turbine outlet temp., °F.          | 675                    | 819       | 848                       |
| Total turbine enthalpy drop, hp.   | 26,770                 | 22,330    | 26,810                    |
| Power available after losses, hp.  | 26,770                 | 21,660    | 26,000                    |
| Net power to load, hp.             | 13,940                 | 6,570     | 10,910                    |
| Air required, lb./hp.-hr.          | 20.69                  | 43.90     | 26.44                     |
| Fuel required, Btu. (LHV)/hp.-hr.  | 5,708                  | 11,440    | 9,120                     |
| Water required, gpm.               |                        |           | 72                        |
| Water required, lb./hp.-hr.        |                        |           | 3.3                       |
| Thermal efficiency, %              | 44.6                   | 22.2      | 27.9                      |
| Exhaust temp. from boiler, °F.     |                        |           | 411                       |

## GAS TURBINES . . .



PROCESS with two heat sources uses low-grade fuel to heat dilution air—(Fig. 4)

erated in boilers fired with fuel which is less suitable for use as a primary gas turbine heat source. Coal, residual oil, and gas of low heating value have been used as gas turbine fuels, but their use in an internal combustion device introduces problems which are avoided when they are used as boiler fuels. The principal problem with gas of low heating value is that usually it must be compressed to the pressure of the compressed air; however low-heating-value gas available under high pressure may be quite suitable for use as a primary heat source in the gas turbine process.

When the heat is available at a temperature level high enough, the steam may well be generated under high pressure and superheated, then expanded through a steam turbine before being used as diluent.

The diluent used in the two-heat-source process may be any suitable fluid available under the pressure at the inlet of the combustion products expander. Thus any gaseous product which leaves a process under pressure and is to be rejected to the atmosphere is potentially a gas turbine process diluent. Gaseous products are in some instances expanded through power recovery turbines, and sometimes they are heated before being so expanded to increase the power output. The use of such a gaseous product as diluent in the combustion gas turbine process

using two heat sources will sometimes be much more economical than its expansion through a power-recovery turbine.

Air can be used as diluent in the two-heat-source gas turbine process, as shown by Fig. 4. Where suitable water is available at reasonable cost it will usually be more economical to use water as the diluent, converting the water to the gaseous state with heat from the secondary source. Where water is scarce or high priced, air may be used, and the gas turbine process carried out so that only part of the fuel consumed is required to be of high grade and high form value.

### Place of Producer Gas

From the earliest period of commercial development of the combustion gas turbine process the utilization of coal has been under study. The problem is to keep the ash from damaging the combustion products expander. Two lines of attack have been explored—mechanical and chemical. The mechanical approach is to remove the ash from the hot gases before they enter the expander. The chemical approach is to convert the coal into an ash-free fuel.

Much work has been done on the ash removal problem in the effort to develop a coal-burning gas turbine locomotive, and some progress has been made. When and if a solution

satisfactory for a locomotive is found, the applicability of the solution to the process industries which depend on coal for power can be considered.

The processing of coal to produce city gas is a well-established industry, which is declining in relative importance in this country because of the spread of natural gas service. City gas made from coal is an excellent gas turbine fuel, but the cost of production is prohibitive. Where coal is processed to make coke, and there is a surplus of the gas produced in coking, the gas can be used in gas turbines; but if coal is to be completely gasified to make gas turbine fuel, the only way which offers a possibility of economic feasibility is to make producer gas.

Hot raw producer gas carries about 90% of the heating value of the coal; cold clean producer gas only about 70%. Standard producers supply gas at substantially atmospheric pressure, so that appreciable compression is required. The hot raw gas cannot be compressed, so that if standard producers are used only about 70% of the heating value of the coal is available to the gas turbine. Some work has been done looking toward the development of a gas producer which would operate under pressure high enough so that the hot raw gas could be burned in the gas turbine. While such a gas producer could probably be developed, the economic incentive seems to be lacking at this time.

Where coal is the fuel of choice and the gas turbine process would be used if the utilization efficiency were improved, consideration should be given to the two-heat-source process, with coal burned to heat the diluent to so high a temperature that only a small additional quantity must be converted to producer gas to supply the combustion products to be diluted. In this way the utilization efficiency can be high even though the producer gas is cooled and cleaned before compression.

Some of the processes mentioned here and in Part II of this article are covered by patents and patent applications owned by The Chemical Foundation, Inc. Release of the information for publication is acknowledged with the author's thanks.

## Checklist for Buying Equipment

### Before requesting bids:

#### Analyze problem to determine:

- Known
- Unknown
- Desired

### After receiving bids:

#### Evaluate

- Process details
- Engineering details

#### Compare

- Capital costs
- Operating costs

#### Discuss with bidder

- Unique design features
- Clarify details

### Evaporator Case History

| Feed                                      | Wt. %  |
|---|--------|
| NaOH . . . . .                            | 9.02   |
| NaCl . . . . .                            | 16.42  |
| Na <sub>2</sub> SO <sub>4</sub> . . . . . | Trace  |
| H <sub>2</sub> O . . . . .                | 74.56  |
|   | 100.00 |

### Product, 27.75 tph.

|                            |        |
|----------------------------|--------|
| NaOH . . . . .             | 49.00  |
| NaCl . . . . .             | 3.00   |
| H <sub>2</sub> O . . . . . | 48.00  |
|                            | 100.00 |

# Guide for Picking the Right Bid

Keep it in mind when buying equipment. You'll get the most for your dollar and cut future headaches. Here's proof in the comparison of bids on an evaporation system for caustic soda.

**E. E. LUDWIG and A. F. SHORKEY**

From the inner sanctum of the board room comes the verdict—Carry project X forward to commercial production.

As you swing your chair back to your desk you face the task of providing a complete evaporation system for the process. How do you proceed?

### It's Not a Stock Item

Although evaporation and its associated equipment have been analyzed and studied for years each new application should receive individual attention. You can't pick a cycle and equipment from a stock list and expect to produce trouble-free operation.

Knowing that, you must present your problem to various equipment manufacturers; let them individually propose cycles and equipment to do

the job. Then you are in a position to select the most suitable system operations-, maintenance- and costwise.

### Give the Complete Story

It may seem strange to belabor an obvious point—furnishing the vendor with complete information. Yet it is estimated that 99% of inquiries presented to equipment companies lack some important, known information.

To avoid such an error of omission the engineer requesting bids must understand the problem sufficiently well to calculate the solution himself. An analysis of the problem should determine what is known, unknown and desired (see table, p. 182).

Under the desired portion of this table are listed operational, material and workmanship guarantees. As furnished by the manufacturer these guarantees should include a specific statement regarding over-all responsibility for equipment such as pumps, separators, valves, etc., not manufactured by the equipment vendor but to

be guaranteed directly by said vendor.

Cooperation between prime and subcontractors should be specifically required. A time limit should be included in the guarantee to prevent dragging out the period needed to meet final expected performance.

Here, a penalty clause is helpful in obtaining satisfaction. It should establish cost per day assumed by the vendor based on lost production.

Also, the guarantee should be worded to prevent the purchaser from paying for items failing to meet guarantees as well as for extra equipment installed by the vendor to help in meeting the guarantee.

### Study and Analyze the Bids

Once bids are all in, you as the engineer responsible may spend several weeks or even months studying and analyzing them. Only thus can you understand completely all equipment.

It would be time-saving and easier to accept the verbal and written recommendation of the vendors but—ex-

**E. E. LUDWIG** is Process Design Manager, Engineering Dept. and **A. F. SHORKEY** is General Superintendent, Caustic Operations, The Dow Chemical Co., Freeport, Tex.

## PICKING THE RIGHT BID . . .

### How Problem Breaks Down

#### Known

- Production rate and analysis of product.
- Feed flow rate, analysis, temperature, (approximate quantity available).
- Services available to serve as design basis for steam, water, gas, etc.
- Disposal of condensate (location) and its purity.
- Probable materials of construction.

#### Unknown

- Evaporation cycle, pressure, temperature (solids capacities and concentration features of various evaporation cycles).
- Number of evaporator effects.
- Best type of evaporator body and heater arrangement.
- Practice of competitors in same and related products.
- Best instrumentation.
- Experience record of manufacturer.

#### Desired

- Answers to Unknown above.
- Operational guarantee.
- Material and workmanship guarantee.
- Performance record of evaporator manufacturer in same or related process.
- Filtering characteristics of any solids or crystals.

#### Details on:

- Equipment dimensions, arrangements, fabrication details.
- Heat transfer surfaces, velocities of fluids, coefficients.
- Separator elements for purity of overhead vapors.
- Types and details of circulating pumps, if any.

#### Utility Requirements:

- Steam
- Power
- Water
- Air

### Review These Design Features . . .

#### Evaporator Body

- Is vapor velocity above the boiling solution reasonable for reducing entrainment? Refer to separator manufacturer for optimum and limiting velocities.
- Is the body adequately baffled to reduce upward entrainment yet maintain low pressure drop?
- Are there limiting (minimum or maximum) operating conditions, and what are they? This refers to flexibility in operation.
- A cone of about 60° is required to prevent salt-bridging in the body and consequent plugging.
- Growth of salt crystals must be controlled to secure good crystal size. Too high a degree of supersaturation yields fine, hard-to-filter crystals.

#### Heaters

- Are heaters horizontal or vertical? In either case, check relative arrangement to insure liquor head covering tubes to avoid dry tubes in heater.
- Is liquor flowing through tubes at about 6-10 ft./sec. average velocity? This appears to be reasonably good velocity for operation.
- What is pressure drop through liquor side of heater?
- A reasonable "U" value for over-all heat transfer appears to be 400 to 500 Btu./hr.deg. F./sq. ft. Some units may run as high as 700 to 800, but check to determine if this value can be maintained under dirty tube conditions.

#### Entrainment Separators

- Is the evaporator body provided with auxiliary means for reducing liquor carry-over with the overhead vapor?
- What is the required outlet vapor specification and what is the guarantee on the separating device?

perience cautions against it. For operations other than evaporation we have found it essential to study in minute detail each step in a process cycle, each piece of equipment, all instruments, pumps, and fabrication details (welding, bolting, access for clean-out, wash-out connections, sight glasses, etc.).

While making such a study remember that the evaporation equipment finally purchased must be lived with for a period of years. No one wants to buy a headache even if apparent costs are low.

There are many ways to approach such a study. Essentially they will each yield the same end conclusion.

The analysis certainly should find the answers to both desired information and details listed in the table.

#### First, Look at Design

Under the listing of desired information are found items pertaining to design. Further amplification of these points is tabulated separately.

The last point covered in this listing deals with outlet vapor specification. This is extremely important if the resultant condensate is to be used. It is also one point often "glossed over" as insignificant by some manufacturers.

Operating data and experience records in writing are some of the most convincing evidence on this point. Most manufacturers of centrifugal vane-type separators guarantee 99% removal of all liquid entering the unit, but it is most important that accurate inlet conditions be known and considered.

#### How It's Built Is Vital

It is of prime importance that fabrication of the equipment meet some minimum standards of construction. Usually the codes of ASME or API-ASME and TEMA are quite adequate.

On investigation, you will find most manufacturers only use these codes where stipulated by state or federal law. Where such enforcement is lacking they revert to their own practice

Permission to publish information originally submitted in confidential bids was freely given by the four vendors involved and is gratefully acknowledged. Names are withheld in the interest of fairness to vendors 2, 3 and 4.

## Comparison of Evaporator Bids from Four Major Equipment Vendors

| Vendor   | 1  | 2   | 3  | 4   |
|--|--|---|--|---|
| <b>Operating Service Requirements</b>                    |  |   |  |   |
| Steam, lb./hr., psig.                                    | 99,500, 110  | 106,000, 65   | 106,000, 75  | 92,000, 110   |
| Main hp.   | 450  | 300   | 375  | 375   |
| Water, gpm., deg. F.                                     | 7,600, 88  | 7,200, 90   | 7,200, 88  | 6,700, 80   |
| Operating hr. per day                                    | 21.6   | 22.0  | 22.0   | 22.0  |
| <b>Principal Evaporation Components</b>                  |  |   |  |   |
| Type evaporator  | Triple effect, backward feed.  | Triple effect, backward feed.   | Triple effect, backward feed.  | Triple effect, backward feed.   |
| Heaters  | Horizontal<br>2 <sup>nd</sup> 1st—8,300 sq. ft.<br>2nd—8,300 sq. ft.<br>3rd—8,300 sq. ft.<br>total 20,100 sq. ft.    | Horizontal<br>1st, 2nd and 3rd avg. 6,500 sq. ft.<br>each, 19,500 sq. ft.<br>total.   | Horizontal<br>1st, 2nd and 3rd each 7,200 sq. ft., total 21,600 sq. ft.  | Vertical<br>1st, 2nd and 3rd each 6,350 sq. ft., total 19,050 sq. ft.                           |
| Main circ. pumps   | Centrifugal (3), 150 hp. each.   | Axial flow (3), 100 hp. each.   | Centrifugal (3), 125 hp. each.   | Mixed flow (3), 125 hp. each.   |
| Separators   | Centriflux units top each evaporator body 9 ppm.   | Centriflux unit top each body, less than 9 ppm.   | Centriflux unit top each body, less than 9 ppm.  | Open-end pipe design no centrifugal element. Do not know if 9 ppm. can be reached, 25 ppm. max. |
| Barometrics  | Included   | Included  | Included   | Included  |
| Salt Crystal   | Reasonable for centrifugal filtration.   | Majority plus 60 mesh, uniform.   | Filtering on centrifugal unit.   | Special emphasis on growing large crystal 60 mesh average.                                      |
| Units operating, Guaranteed                              | Yes  | Yes   | No   | No  |
| <b>Equipment Furnished and Materials of Construction</b> |  |   |  |   |
| Evaporator bodies  | 10 dia. x 33 ft. x 7/16 in.<br>10 1/2 x 33 ft. x 7/16<br>11 1/2 x 25 ft. x 7/16<br>All 20% Ni-Clad                   | 17 dia. x 27 ft. x 1/8 in. min. nickel thickness on all effects.  | 11 dia. x 15 ft. x 3/8 in.<br>14 1/2 x 15 ft. x 7/16<br>20 x 15 ft. x 7/16<br>All 20% Ni-Clad                                      | 18 dia. x 9 ft. x 3/4 in.<br>18 x 9 ft. x 3/4<br>20 x 9 ft. x 3/4<br>All 10% Ni-Clad            |
| Circulating pumps  | 13,100 gpm. each, solid nickel, Ingersoll-Rand.  | Gpm. not given, solid nickel, Bingham.  | 11,000 gpm each, solid nickel, Ingersoll-Rand.   | 16,000 gpm, solid nickel, Ingersoll-Rand.   |
| 1st effect, 2nd effect                                   | 13,100 gpm. each, solid nickel, Ingersoll-Rand.  | 1st—8 dia. x 4 ft., 2nd—10 x 4 ft., 3/16 in. solid nickel wall, w/60° cone.   | 1st—8 dia. x 4 ft., 2nd—10 x 4 ft., 3/16 in. solid nickel wall, w/60° cone.  | Included  |
| 3rd effect   | 13,100 gpm. each, solid nickel, Ingersoll-Rand.  | Monel from 1st effect, carbon steel from 2nd and 3rd, monel from flash tank to 3rd effect, prefab. except for one field weld each.        | Monel from 1st effect, carbon steel from 2nd and 3rd, monel from flash tank to 3rd effect, prefab. except for one field weld each. | 3, 18 ft. dia. tapered to 15.75 x 10 x 3/4 in.  |
| Motors   | Included   | Nickel where in contact with liquid, balance carbon steel, prefab.  | Nickel wall, w/60° cone.   | 10% Ni-Clad.  |
| Salt tanks   | Incorporated in evaporator body.   | 1st—10 x 10 ft. nickel-clad steel, 1/8 in. min. Ni.   | Monel from 1st effect, carbon steel from 2nd and 3rd, monel from flash tank to 3rd effect, prefab. except for one field weld each. | Nickel elbow at evaporator, remainder carbon steel, prefab.                                     |
| Overhead vapor piping                                    | All carbon steel, w/ 1/8 in. corrosion allowance, prefab.  | Nickel where in contact with liquid, balance carbon steel, prefab.  | Nickel where in contact with liquid, balance carbon steel, prefab.   | Nickel, prefab.   |
| Large liquor piping                                      | Nickel, 3/16 in. wall, prefab.   | Nickel, prefab.   | Nickel, prefab.  | Nickel, prefab.   |
| Small process piping                                     | Liquor piping connecting effects and pumps of nickel, valves & fittings, control valves of nickel. Furnished prefab. | Nickel piping and fittings. Control valves butterfly type, other plug type. Piping furnished random lengths for fabrication by purchaser. | Nickel piping w/monel valves, control valves butterfly type. Pipe prefab.  | Nickel Sch. 10 in random lengths for fabrication by purchaser.                                  |
| Instrumentation  | Complete   | Minimum requirements  | Complete   | Very complete   |
| Miscellaneous by vendor                                  | Structural steel supports (no platforms, walkways, stairways).   | Mountings (not supports).   | Mountings (not supports).  | Supports not included.  |
| Engineering drawings                                     | Equipment—genl. assembly, plans, elevations, flow-sheets, piping.  | Equipment—genl. assembly, plans, elevations, flow-sheets, piping.   | Equipment—genl. assembly, plans, elevations, flow-sheets, piping.  | Equipment—genl. assembly, plans, elevations, flow-sheets, piping.                               |
| Code construction  | ASME, heaters only to be stamped.  | Not given   | Not given  | ASME-U-69, heaters only to be stamped.  |
| <b>Cost Comparison*</b>                                  |  |   |  |   |
| Equipment and material by vendor                         | 1.00   | 0.997   | 0.975  | 1.18  |
| Extra rigging for field assembly                         | None   | 1.5   | None   | 1.8   |
| Piping erection  | 1.00   | Included above  | 1.00   | Included above  |
| Structural steel   | Included   | 4.0   | 3.5  | 3.5   |
| Foundation extra, due to weight and size                 | None   | 2.5   | 2.5  | 2.5   |
| Extra for spare pipe and equipment required by purchaser | 1.00   | 0.402   | 0.402  | None  |
| Extra instruments  | 1.00   | 1.50  | 1.00   | None  |
| Extra engineering  | None   | 0.90  | 0.80   | 1.00  |
| Freight  | 1.00   | 1.18  | Included   | 1.27  |
| Final ratios (expected erected cost)                     | 1.00   | 1.08  | 0.927  | 1.21  |

\* Not given, assumed from other information. <sup>1</sup> First effect is considered unit being fed primary steam, thus producing the highest concentration of product. <sup>2</sup> Not furnished. <sup>3</sup> Cost ratios are on an erected basis referenced to vendor no. 1. The ratios given hold relatively within a given row, and are not additive in any column.

## PICKING THE RIGHT BID . . .

### Compare These Cost Elements

#### Capital Costs

Foundations as dictated by equipment weights.  
Ground area and building (if housed) requirements.  
Utility services, noting differences in pipe or cable sizes needed.  
Structures for servicing, operating and supporting the equipment.  
Piping for evaporation cycle.  
Requirements for owner-furnished materials.  
Back-up capital of owner.

#### Operating Costs

Steam consumption and pressure.  
Power requirements.  
Cooling water.  
Equipment to meet guarantees on liquid entrainment in overhead vapor.  
Operating labor.  
Maintenance and shop labor.  
Supplies for efficient operation.  
Down-time for wash-outs and boil-outs.  
Convenience of design for operation.  
Wash water allowances.  
Experience records in service and reputation for fulfilling all contracts.

for design and shop fabrication standards. Obviously, these vary considerably between manufacturers.

Fabricating details are extremely important where alloy steel, nonferrous or clad plate materials are used. Pay particular attention to head and shell welds, intermediate head welds, top and side nozzles, bottom nozzles, manholes and large diameter nozzles. Examine for pockets, improper welding rods, welding sequence, adequate weld protection to prevent contamination pickup, and adequate reinforcement.

#### And How About Cost?

By the time you have explored all the aforementioned topics you are ready to take a look at the prime factor—what are comparative costs?

A true picture of the comparative total costs for any installation cannot be complete until capital and operating costs for each system are evaluated, as installed. Some differences to weight are tabulated.

In some situations, a relative evaluation of these points will be sufficient. In other cases it will be necessary to prepare accurate cost estimates of the actual expected costs prior to selection of a manufacturer.

Quite often evaporator makers include in the package certain piping, pumps, motors, vessels, barometric vacuum units, instruments, etc. However, there is no uniformity—some do, some don't. Thus in making comparisons between bids care must be taken to segregate the comparable

items and isolate the "extra" or special ones.

#### Seller Faces Buyer

During the course of your studies you will undoubtedly be submitting questions to the vendors for clarification. On any reasonably large job it is usually necessary to have a personal discussion with a responsible technical representative of each manufacturer. Otherwise, it may be impossible to do justice to features of each manufacturer's design.

When you finally select the manufacturer to build your system it marks the real beginning of the project. Hundreds of details, impossible to cover in any proposal, must be handled under the interpretation of the agreement.

Your job as the engineer is not finished until the unit makes total production. Even then the production engineer is still living with the unit to iron out all the bugs and start making improvements and desired modifications.

#### From the Job-Completed File

By way of illustration we can look at a job that was submitted for bids, then compare the bids and see which was selected.

The bidders were requested to:

Furnish evaporation equipment to produce 51,500 lb. per hr. of 49.0% NaOH liquid starting with a feed liquid at 144 F. that analyzes:

|                                 | Wt. %  |
|---------------------------------|--------|
| NaOH                            | 9.02   |
| NaCl                            | 16.42  |
| Na <sub>2</sub> SO <sub>4</sub> | Trace  |
| H <sub>2</sub> O                | 74.56  |
|                                 | 100.00 |

The system must produce product that analyzes:

|                  |        |
|------------------|--------|
| NaOH             | 49.00  |
| NaCl             | 3.00   |
| H <sub>2</sub> O | 48.00  |
|                  | 100.00 |

Production basis will be 100% of operating time. Vendor must make allowances to insure a guaranteed tonnage per month based upon the above rate. The performance guarantee is to be for a 30 day operation.

Steam is available at pressures up to 110 psig. saturated.

Condensate produced by evaporation is to be used for steam generation in high pressure boilers. It must have a guaranteed maximum impurity of 9 ppm. combined chloride and hydroxyl ion. This specification also applies to vapor going to the barometric condenser. If excess impurities enter they will form precipitates with the condenser water.

Manufacturer is to furnish flow diagram of evaporation system proposed. It must include calculated flow rates, temperatures, pressures and analysis around each unit.

Manufacturer is to furnish information regarding size of each piece of equipment furnished or required and the heat transfer surface for each unit.

Materials of construction of the equipment are to be recognized as resistant to the solutions handled. Nickel is preferred where necessary to prevent iron contamination.

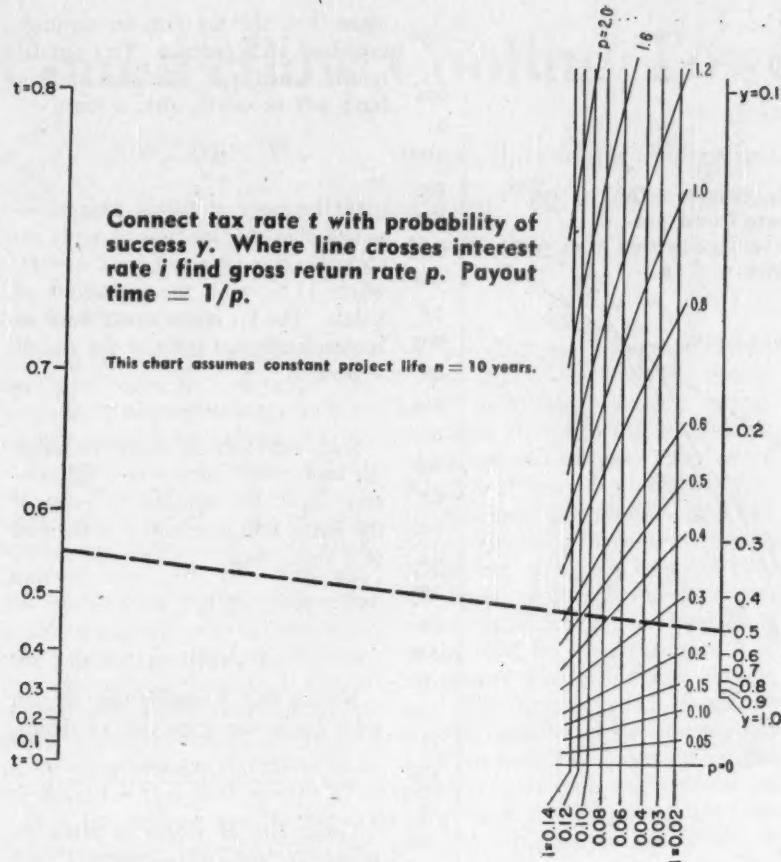
Furnish details of welded and bolted connections for review. State codes of construction and design used for the various items.

#### Evaluating and Selecting

Replies from reputable manufacturers on an inquiry of this nature will usually be reasonably close on the cost of the basic units. But as previously noted an examination of the over-all total installation picture is needed to complete a thorough analysis.

A comparative table, p. 183, of evaporator bids from four major equipment vendors, makes for easy reviewing of the major items of concern for each bid. Various sections in the table cover operating service requirements, principal components for the proposed flow cycle, equipment furnished together with materials of construction, and cost ratios on an erected basis.

The system and equipment finally selected were those offered by vendor 1. The primary reasons were (1) in lower cost bracket, (2) between vendors 1 and 3 it was found that vendor 1 had experience evidenced by installed, operating systems, (3) completeness of package offered, (4) requires less space because evaporators are smaller.



## Solve for Payout Time

. . . with these two nomographs. Based on the Happel approach to payout calculations, these charts help you compare the attractiveness of a proposed risk venture against the return from a relatively safe investment.

### E. YANAGISAWA

In an article published in *Chemical Engineering* in Oct. 1951 (p. 141), Happel proposed a new method for calculating payout times on risk investments. This method differed from convention in three respects: It took

into account the effect of changes in tax rates; it allowed for the probability of success or failure; it considered the future value of income, depreciation and investment over the life of the project.

Happel derived some algebraic expressions in terms of specific assumed values for certain variables. I have derived similar expressions in generalized terms and have constructed nom-

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### About this article and the nomographs, Prof. Happel comments:

Mr. Yanagisawa's article appears to be a logical extension of my earlier article in *Chemical Engineering*. However, there are several newer qualifications which, if incorporated into this article and the nomographs, would somewhat extend their usefulness.

In the first place, after numerous conversations and on further considerations, I have concluded that the figure of 3% assumed for a safe investment is entirely too low. This is not because one can get more than 3% interest in savings banks or in government securities, but because businesses which probably have at least a 95% chance of success customarily require a 10% return on investment in order to attract capital.

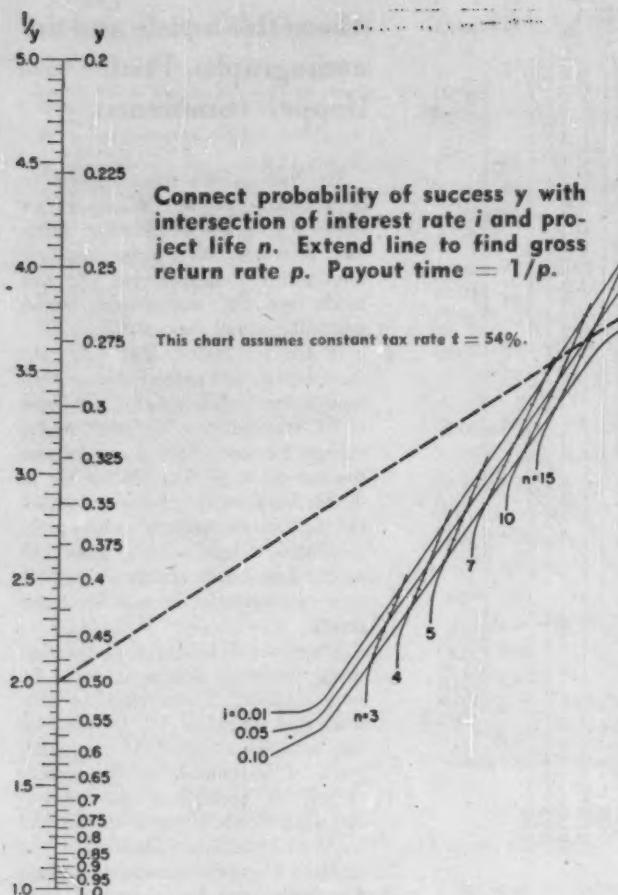
Therefore, I believe that the formulas previously developed would be more significant if something like 10% were used instead of 3% for the base case involving a completely safe investment. Uncertainties in the experimental or preliminary development stages are much higher than this and could be evaluated as described in the article. Thus the nomograph which Mr. Yanagisawa has given would be more useful if it covered a range of, say, 5 to 20% for values of  $i$ , the minimum acceptable return.

Secondly, the earlier article assumed that the rate of depreciation allowable for tax purposes, and the rate of depreciation which corresponds to a uniform payment into a sinking fund which will return the investment after an assumed life, are the same.

For example, at a figure of 3% interest in ten years, the annual depreciation rate is 8.72%. This presupposes that the government will also allow an 8.72% rate. Assuming a straight-line depreciation, as is usually used by the government for tax purposes, this rate would correspond to a life of approximately 11.5 years, instead of the ten years assumed for accounting purposes. At higher assumed interest rates the difference would, of course, be larger.

Probably a different nomograph could be constructed taking this situation into account. The formula would necessarily be a bit more complicated. It might be worthwhile for the author to explore this possibility.—JOHN HAPPEL, Professor and Chairman, Department of Chemical Engineering, New York University.

## PAYOUT TIME



ographs which permit rapid solution of the equations.

Following Happel's original argument, let us assume that the alternative to investing in a proposed risk venture is to buy safe securities which will earn income at a rate of  $i$  per year (expressed as a decimal). We assume also that the life of the proposed venture will be  $n$  years, that we can neglect inflationary or deflationary trends and that the investment will have no salvage value at the end of its life.

The value of our initial "safe" investment  $I$  after  $n$  years is given by the expression  $I(1+i)^n$ . In order for our proposed risk venture to be attractive, therefore, its total accrued return (including depreciation) must be equal to at least  $I(1+i)^n$  at the end of  $n$  years.

Happel developed methods for calculating the value of accrued return for either of two conditions—continued success of the venture or immediate, complete failure. If the venture is

successful, net annual earnings and depreciation are paid into a sinking fund to recover the value of the investment. This sinking fund is reinvested in safe securities to continue earning at the rate of  $i$  per year.

If  $p$  is a decimal expressing the gross annual return as a function of the investment and  $y$  is a decimal expressing the probability of success, then the probable gross annual return is  $pyI$ .

Annual depreciation allowance is less than  $I/n$ , because we get the benefit of our sinking fund interest over the period of  $n$  years. Actual depreciation rate, which will generate the full initial investment after  $n$  years, is

$$\frac{i}{(1+i)^n - 1} = d$$

Since our earnings tax is based on gross return less depreciation  $pyI - dyI$ , we shall have left after taxes

$$pyI - (pyI - dyI)t$$

where  $t$  is the tax rate on earnings expressed as a decimal. This annual return, when put into our sinking fund, will be worth, after  $n$  years,

$$\frac{pyI - (pyI - dyI)t}{d}$$

In the event of failure, Happel assumed that the loss was partially recoverable by a tax credit of  $(1-y)It$ , where  $(1-y)$  is the probability of failure. The tax credit would have an accumulated asset value at the end of  $n$  years of

$$(1+i)^n(1-y)It$$

Since total accrued return—whether the venture is a success or a failure—must equal the appreciated value of the initial safe investment at the end of  $n$  years, then

$$\frac{pyI - (pyI - dyI)t}{d} +$$

$$(1+i)^n(1-y)It = (1+i)^n I$$

Noting that  $I$  cancels out, we can solve for  $p$ , the gross rate of return:

$$p = \frac{it}{1-y} + \frac{i(1+i)^n/y}{(1+i)^n - 1} = \frac{1}{T}$$

Gross rate of return is often expressed in terms of its inverse  $T$ , payout time.

In the first of the two nomographs, I have assumed that  $n$  is constant at 10 years. In the second nomograph,  $t$  is constant at 0.54, which is the current U.S. federal corporate tax rate of 52% plus 2% to allow for average state tax.

For example, assume a proposed venture with an expected life of 10 years and a probability of success of 50%, or  $y = 0.5$ . With safe investments yielding 3% per year ( $i = 0.03$ ) and a tax rate of 54% ( $t = 0.54$ ), what should be the minimum gross return to make this venture attractive?

On the first nomograph, connect  $t = 0.54$  with  $y = 0.50$ . Where this line crosses  $i = 0.03$ , read the answer,  $p = 0.28$ , or 28%. The maximum payout time would be  $1/0.28 = 3.6$  years.

We can solve the same problem with the second nomograph, since the tax rate is 54%. Connect  $y = 0.50$  with the point marking the intersection of  $i = 0.03$  and  $n = 10$ . Extend the line to find the value of  $p = 0.28$ .

## HOW TO EVALUATE VARIABLES IN . . .

# Counterflow Cooling Towers

What effect will a change in the water flow rate have on the water temperature? How does the fan speed affect tower performance? Here's the way to get accurate answers to such questions.

### JACK WHITESELL

There are few pieces of industrial equipment which have so caught the imagination of engineering and operating personnel as have cooling towers.

As with other equipment, there's been an enormous number of articles written about various phases of correlation, operation, and economics. However, very little has been said that really gives the plant operator or design engineer practical considerations usable on actual installations. For this reason there is a certain amount of misconception and unnecessary confusion involved in the purchase, operation, and control of cooling towers.

It is the purpose here to present certain practical considerations and approximate working tools which may be of some help to an engineer or operator working with cooling towers.

### Tower Characteristics

Cooling towers are designed to meet a condition of operation specified by the customer. This condition is that of cooling a specified water quantity (gpm.) through a definite temperature gradient (range) to a final temperature which is a certain number of degrees above the design wet bulb (approach). Specifications for cooling are usually in these terms of gpm, range, approach, and wet bulb. Only infrequently will the tower operate at this point since the plant will normally level out at a slightly different requirement and/or the wet bulb will be other than design. For these very reasons tables or graphs of cooling tower operation at other than design

are supplied by the manufacturer.

The design wet bulb is usually based on Weather Bureau Records and often chosen as the temperature which will not be experienced more than 5% of the time during the summer months of June, July, August, and September. Most handbooks present design wet bulb data based on this 5% figure. Although this is a convenient reference or guide post, it is certain that in numerous cases it is an entirely inadequate basis for design. The design wet bulb should be selected only after some reference has been made to the economics of the plant being served, the seasonal requirements of cooling, and the tabulated Weather Bureau Record for the locality. Microfilm data is available on many hundreds of stations where hourly readings have been made and condensed for rapid interpretation.

Cooling tower performance curves as normally supplied by the manufacturer are of the form shown in Fig. 1. The effect of variance in range, approach, or wet bulb may be easily observed. Other performance curves may be presented for varying water quantity (normally plus and minus 5%-10%) as well as data on half speed fan duty and fans off (natural draft operation).

### Some Curves of Performance

A convenient estimating curve which will prove useful in general plant operation is shown in Fig. 2. The percentage change in gpm. which will cause a 1 F. change in cold water temperature is shown as a function of the effective height of cooling ( $H_e$ ) and design or operating Approach. An increase in gpm. will naturally have the effect of increasing the cold water temperature. The cooling range is assumed to be constant.

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• For example: if we take the case of a tower with a 35-ft. effective height of cooling, the design or operating approach is 10 F., and we wish to determine what change in gpm. will be required to decrease the approach or  $T_s$  by 1 F., an inspection of Fig. 2 reveals that approximately a 10% reduction in gpm. is required.

Performance curves for tower operations with fans at half speed may be drawn which will give approximation figures for estimating. One such correlation is shown in Fig. 3; it gives the change in approach to be expected at half speed for varying heights of towers. This correlation is dependent upon the approach normally occurring at full speed. The range, gpm., and wet bulb are assumed to be constant for both conditions of fan operation.

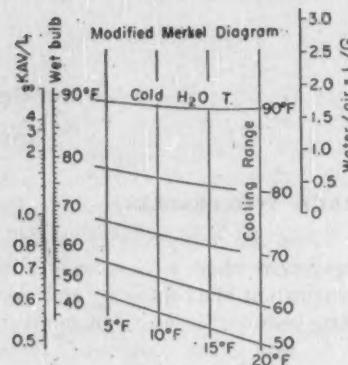
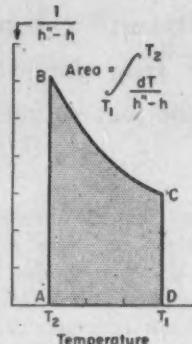
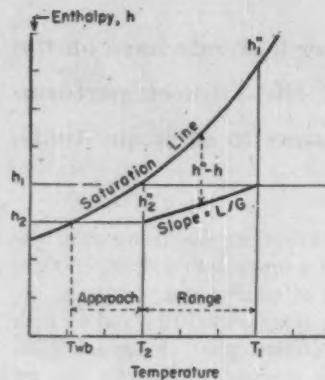
• For example: a tower with a 35 ft. effective height of cooling will give a half speed approach of 26 F. provided the design or operating approach at full speed is 14 F.

A general correlation may be made for determining the wet bulb temperature at which fans may be reduced to half speed—Fig. 4. This is based on maintaining design or operating hot and cold water temperatures.

• For example: a tower with a 35-ft. effective height of cooling and a design or operating Approach of 10 F. at full speed will require a 26 F lowering in wet bulb in order to maintain the same hot and cold water temperatures.

Figs. 2, 3, and 4 are of general application for counterflow towers that make use of the more common splash-type filling for cooling. Average values from many types of cooling tower packing tested have been used as a basis for these correlations. The effective height of cooling ( $H_e$ ) for counterflow towers may be taken as the distance between the drift elim-

## This Is the Theory Behind Evaluation Methods . . .



One of the most prominent theories of counterflow cooling tower performance and correlation was developed in 1925 by Merkel<sup>1</sup>. This approach, although frequently contested because of enthalpy being considered as the driving force, has nevertheless been widely accepted by the majority of industry. Certain modifications have been considered by the researcher and manufacturer for a more refined correlation. However, the basic equation stands on its own merits as a remarkably workable engineering tool. In the integrated equation form the Merkel equation is presented as:

$$KaV/L = \int_{T_1}^{T_2} \frac{dT}{h'' - h} \quad (1)$$

### Correlation of the Data

To illustrate the process of determining the cooling tower performance coefficient ( $KaV/L$ ), it is best to refer to the graph where the saturation enthalpy of air is plotted against temperature. From test data where  $T_w$ ,  $T_b$ , and  $T_{wb}$ ,  $L$ , and  $G$  are known, you can readily construct the operating line. The conditions at the bottom of the tower are represented by point  $(T_w, h_w)$ , with  $(T_w)$  representing the cold water temperature and  $(h_w)$  the enthalpy of the entering air. This provides one point on the tower operating line. Point  $(T_w, h''_w)$  is the enthalpy of air were it saturated at the temperature  $(T_w)$ . The difference between  $(h''_w)$  and  $(h_w)$  may be considered as the "enthalpy potential" or "driving force" which is defined as existing at the bottom of the tower.

The slope of the operating line is equal to  $L/G$ , since the heat lost by the water is equal to the heat gained by the air ( $LdT = Gdh$ ). We may neglect the reduction in water quantity in the tower due to evaporation. With point  $(T_w, h_w)$  and the slope  $L/G$ , the operating line may be extended to  $(T_1, h_1)$ .  $(h''_1)$  minus  $(h_1)$  may then be expressed as the enthalpy poten-

tial existing at the top of the cooling tower.

The potential at any point between  $(T_1)$  and  $(T_2)$  may then be expressed as  $(h'' - h)$ . The integral

$$\int_{T_1}^{T_2} \frac{dT}{h'' - h}$$

now may be shown as equal to the area ABCD shown above. This value can be determined by planimeter, rectangular count, summation of incremental values of the integral over small ranges, or by log mean enthalpy potential (providing the range is small).

These graphical methods of handling the integration of the Merkel equation are somewhat time consuming until a certain degree of familiarity has been gained. For accurate results the exact area represented by this equation must be determined.

Any one design of cooling tower may, by test, be represented by a correlation of  $KaV/L$  vs.  $L/G$ . This is true since  $KaV$  is a function of  $L$  and also  $G$ . For each tower design there is a specific value of  $KaV/L$  for any liquid to gas ratio ( $L/G$ ). These two factors will plot out as straight line on log-log paper over the range of normally experienced ratios of  $L/G$ . The correlation is somewhat affected by magnitudes of  $L$  and  $G$ ; but again for normally experienced values, they do not spread the correlation unduly.

### Merkel's Approximate Solution

By making rather broad assumptions, Merkel has presented a convenient equation in terms of cooling factor ( $\alpha$ ) where:

$$\alpha = \frac{h''_m - h_2}{\Delta T} = \frac{L}{KaV} + \frac{L}{2G} \quad (2)$$

with  $h''_m$  defined as:

$$h''_m = \frac{1}{\Delta T} \int_{T_1}^{T_2} h'' dT \quad (3)$$

Wood and Betts<sup>2</sup> have prepared a modifi-

cation of an original Merkel nomograph published in 1926. This more convenient nomograph, reproduced here, is an expression of Eq. 2 wherein the value  $KaV/L$  may be readily determined from range,  $T_s$ ,  $T_{wb}$ , and  $L/G$ .

Reproduction has been made here to help in the understanding of how much and in what manner each variable affects the other. The accuracy is somewhat limited since certain approximations were introduced to allow the chart to be drawn up in this convenient form. A rather complete coverage of the deviations from the exact integration of Eq. 1 have been presented by Chilton<sup>3</sup> who has drawn a similar nomograph in terms of ( $\alpha$ ). He has graphically summarized his accuracy tests in terms of  $T_s$  for various  $L/G$  ratios.

Normally mechanical draft cooling towers are designed for  $L/G$  ratios ranging from 0.75 to 1.50, and accordingly the values of  $KaV/L$  vary from 0.50 to 2.50. With this range of conditions in mind, a little familiarity with handling the nomograph will do much in explaining what happens as each variable is changed.

For example: if a given tower is operating with a 20 F Range, a cold water temperature of 80 F, and a 70 F wet bulb, a straight line may be drawn on the nomograph. If the  $L/G$  ratio is calculated to be 1.00, then  $KaV/L$  may be established by a line drawn through  $L/G$  and parallel to the original line. The cooling coefficient  $KaV/L$  is thus established as 1.42. Let us then assume that if the wet bulb were to drop to 50 F, the  $L/G$  and  $KaV/L$  ratio may be assumed to remain reasonably constant. A new line parallel to the original will then show that for the same range the cold water temperature will drop to 70 F.

It must be realized that this nomograph is an approximate solution and the degree of accuracy will vary with changes in cooling as well as from tower to tower. There is no real substitute for the exact integration of Eq. 1.

inator and basin curb. These correlations are sufficiently accurate to use in most cases of estimating. However, more exact curves for specific installations may be obtained upon request from the manufacturer.

### Fan Performance Curves

Cooling tower fans have been built in a variety of types, shapes, and sizes over the past twenty years. In their present form they show the results of engineering for special requirements in corrosion, stressing, efficiency, and large delivery against low resistance. The blade sections vary in appearance from that of the early aeroplane propellers to that of an axial flow fan. Horsepower curves are fairly flat throughout the normal design region and therefore small changes in pressure drop will not materially affect the motor loading. Their performance follows the fan laws with fine accuracy provided the test unit used in establishing their data is not less than 0.4 scale.

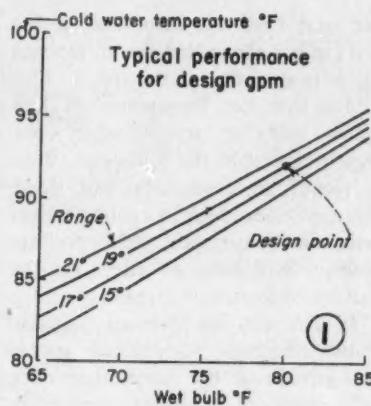
The first basic fan law is tabulated as follows<sup>6</sup>:

#### Ratio of

$$\begin{aligned} \text{Cfm.} &= \text{rpm.}^1 \times D^3 \times 1 \\ \text{Sp.} &= \text{rpm.}^2 \times D^2 \times \rho \\ \text{Hp.} &= \text{rpm.}^3 \times D^5 \times \rho \end{aligned}$$

For example a point of rating on a fan performance curve (cfm., sp, hp) may be transferred to that at another rpm.; diameter; and fluid density by use of the above relationships. This set of fan laws applies to geometrically similar series of fans. The relationships of rpm. and density may be applied to non-geometrically similar fans provided the diameter relationship is not required.

Cooling tower fans may have a different design of air foil section for each size or all sizes may be built geometrically similar to one another. In the first case, as a size of fan is contemplated for production it is necessary to build up a completely different design from that of the next size in the series. This requires a multitude of fan rating data and consequently a vast amount of test work on each and every size or scale model. On the other hand a highly efficient design may be developed which can be used for all sizes, by merely making each fan geometrically similar in every respect to the others in the series.



### Effect of Fan Pitch Angle

It is interesting to observe how a fan will perform with various pitch angle settings. Fig. 5 is a plot showing how a cooling tower fan will perform over a wide range of cfm. and static pressure conditions. This particular plot is typical of a rather low efficiency blade design. Static efficiency has been plotted against the specific speed characteristic "N,"<sup>4</sup> for

various pitch angle settings where:

$$N_s = \frac{(\text{rpm.})(\text{cfm.})^{1/4}}{(\text{sp.})^{3/4}} \quad (4)$$

This correlation is independent of fan size and shows peak efficiencies for various pitch angles occurring between 155,000 and 170,000 specific speed. Also it is noted that the efficiency of this typical design increases with pitch angle up to 16°. Any further increase in pitch results in a decline in efficiency. This is generally true of all fans regardless of design.

By arbitrarily choosing values of cfm and static pressure, and holding  $N_s$  constant at 170,000 (peak for this design at 16°), we may then compute data for Fig. 6. For any required cfm. and static pressure it is then possible to establish the exact fan speed to be used with the most efficient pitch angle. The fan diameter to be used with this speed, however, is unknown and must be established by cross plot of  $N_s$  with the Specific Diameter Character "D,"<sup>4</sup> where—

$$D_s = \frac{D \times (\text{sp.})^{1/4}}{(\text{cfm.})^{1/2}} \quad (5)$$

The value of  $D_s$  corresponding with 170,000  $N_s$  is in this case 0.00259. Again arbitrary values of cfm. and static pressure may be assumed and values of  $D$  computed. Fig. 7 represents such a plot for establishing optimum diameters.

### How to Get Peak Efficiency

Fig. 6 and 7 may then be used to determine the most efficient combination of fan size and speed for a given cfm and static pressure. It is apparent that certain combinations of cfm and static pressure will result in sizes and speeds not always available because of size breaks in fan diameters as well as normally supplied gear ratios. It is for these reasons that other pitch angles are available for flexibility. In certain cases it is not practical to design for peak efficiency since this would result in high first cost. Each cooling tower design must be considered as an individual case and the fan selected on the basis of the installation requirements.

It is apparent that the peak efficiency of a fan must be met with reasonable exactness on any cooling tower installation where fan horsepower is considered along with the

#### NOMENCLATURE

|                      |   |
|----------------------|---|
| <b>K</b>             | Diffusion coefficient, lb./sq. ft./hr. (lb./lb.)  |
| <b>a</b>             | Interfacial area, sq. ft./cu. ft.   |
| <b>V</b>             | Active cooling volume, cu. ft./sq. ft. of plan area                                       |
| <b>L</b>             | Water rate, lb./hr.   |
| <b>G</b>             | Air rate, lb. dry air/hr.   |
| <b>L/G</b>           | Commonly referred to as liquid to gas rate lb./lb.  |
| <b>T</b>             | Water temperature, F.   |
| <b>Twb</b>           | Wet bulb temperature of entering air, F.  |
| <b>Range</b>         | Water temperature change accomplished by tower, F.  |
| <b>h</b>             | Enthalpy of air stream, Btu./lb. dry air  |
| <b>h"</b>            | Enthalpy of saturated air at water temperature, Btu./lb. dry air                          |
| <b>h'"</b>           | Mean value of $h''$ as defined by Merkel equation, Btu./lb. dry air                       |
| $\alpha$             | Cooling factor as defined by Merkel equation  |
| <b>H<sub>e</sub></b> | Effective cooling height defined as distance between drift eliminator and basin curb, ft. |
| <b>Hp.</b>           | Horserpower   |
| <b>Gpm.</b>          | Water rate, gal./min.   |
| <b>Rpm.</b>          | Fan speed, rev./min.  |
| <b>Cfm.</b>          | Air rate, cu. ft./min.  |
| <b>D</b>             | Fan diameter, ft.   |
| $\rho$               | Air density, lb./cu. ft.  |
| <b>N<sub>s</sub></b> | Fan performance characteristic, "Specific Speed"  |
| <b>D<sub>s</sub></b> | Fan performance characteristic, "Specific Diameter"                                       |
| <b>Se.</b>           | Static efficiency   |
| <b>Sp.</b>           | Static pressure, inches water   |

Subscript 1 Refers to conditions at top of tower

Subscript 2 Refers to conditions at bottom of tower

## COOLING TOWERS . . .

### Typical Fan Hp. Requirements

| Wet<br>Bulb<br>F.           | No. Fans      | % Design<br>Fan Hp. | % Design<br>Rpm. |
|-----------------------------|---------------|---------------------|------------------|
| <b>Single Speed Motors</b>  |               |                     |                  |
|                             | On            | Off                 |                  |
| 77                          | 8             | 0                   | 100              |
| 75                          | 8             | 0                   | 100              |
| 73                          | 8             | 0                   | 100              |
| 70                          | 8             | 0                   | 100              |
| 65                          | 7             | 1                   | 88               |
| 60                          | 7             | 1                   | 88               |
| 55                          | 7             | 1                   | 88               |
| 50                          | 7             | 1                   | 88               |
| 45                          | 6             | 2                   | 75               |
| <b>Two Speed Motors</b>     |               |                     |                  |
|                             | Full<br>Speed | Half<br>Speed       |                  |
| 77                          | 8             | 0                   | 100              |
| 75                          | 8             | 0                   | 100              |
| 73                          | 7             | 1                   | 90               |
| 70                          | 6             | 2                   | 78               |
| 65                          | 4             | 4                   | 56               |
| 60                          | 3             | 5                   | 45               |
| 55                          | 2             | 6                   | 34               |
| 50                          | 1             | 7                   | 23               |
| 45                          | 0             | 8                   | 13               |
| <b>Variable Speed Drive</b> |               |                     |                  |
|                             |               | 100                 |                  |
| 77                          |               | 78                  | 92               |
| 75                          |               | 64                  | 86               |
| 73                          |               | 50                  | 79               |
| 70                          |               | 34                  | 69               |
| 65                          |               | 24                  | 62               |
| 60                          |               | 18                  | 57               |
| 55                          |               | 14                  | 52               |
| 50                          |               | 11                  | 48               |

first cost for a long term pay out period. The cooling tower manufacturer has other variables along with the flexibility in fan size, speed, and pitch angle which are used to establish an optimum selection. These include number of fan blades per fan, cell size, tower height, type of distribution system, and type of packing. There are many combinations of tower sizes and equipment that will satisfy any one cooling requirement.

Bear in mind that a cooling tower selection (quotation) is only as good as the inquiry. Requests for quotation for a specific gpm and temperature conditions are not sufficient in most cases since there are unlimited combinations of cooling towers which will meet these requirements. If the manufacturer is provided with sufficient information to know exactly how a particular quotation is to be judged he can then offer his best selection.

### Static Efficiency Equation

Fans supplied on towers receiving strict evaluation of power are frequently furnished with two speed motors. Variable speed drives may also be used for these services. These extra control measures allow the fan horsepower to decrease with the wet bulb

and heat load. An inspection of the first fan law shows that fan horsepower varies as the cube of the speed. This means that fan horsepower at half speed will be approximately one eighth of that at the full speed. This is almost an exact ratio but slight variation does occur in cooling towers since the density and static pressure variance will have an effect on the half speed horsepower reading.

It may also be observed that the static efficiency at reduced speeds will remain at the same high value as experienced at design conditions. If the variables in the equation for static efficiency are adjusted for half speed conditions (see fan laws—effect of rpm.) the fan law multipliers cancel out and result in the same efficiency—

$$\text{Static Eff.} = \frac{\frac{1}{2} \text{ Cfm.} \times (\frac{1}{2})^3 \text{ Static press.}}{6356 \times (\frac{1}{2})^3 \text{ Horsepower}}$$

$$= \frac{\text{Cfm.} \times \text{Static press.}}{6356 \times \text{Horsepower}} \quad (6)$$

trollable fan speeds are the recommended answer.

Since cooling towers are rated for specific design conditions it is also common practice to report fan horsepower which will be experienced at design. Total horsepower reported in a quotation normally includes fan horsepower at design plus gear loss. This results in motor output horsepower at design conditions. If an evaluation of power requirements is essential the motor output horsepower must be converted to motor input by the use of motor efficiency.

One point that is frequently in question or overlooked is the fact that fan horsepower is a direct function of the density of the air it is handling. (See first fan law.) For this reason the fan horsepower will be slightly greater during cold weather operation or at reduced heat loads. This increase in horsepower is a reasonably small percentage over design since the variance in exit air density is small.

Changes in fan horsepower caused by a change in water rate over the tower will be almost insignificant. A variance in water rate will result in a change in tower pressure drop, but the horsepower curves for cooling tower fans are reasonably flat in the normal region of design. So little change in power will be experienced.

### To Sum Up

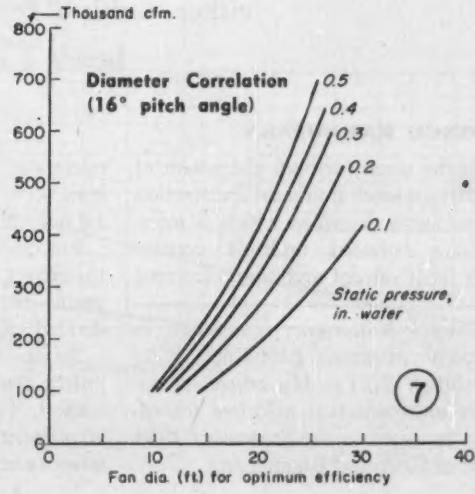
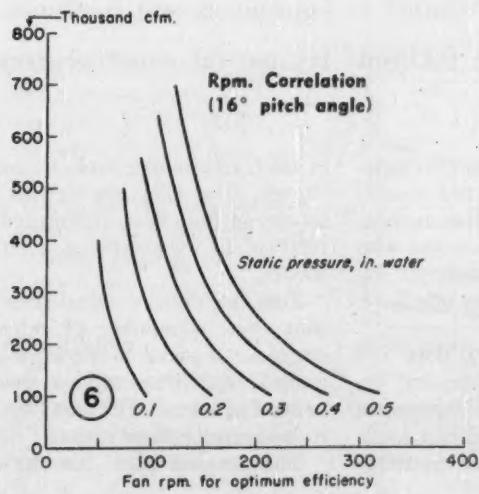
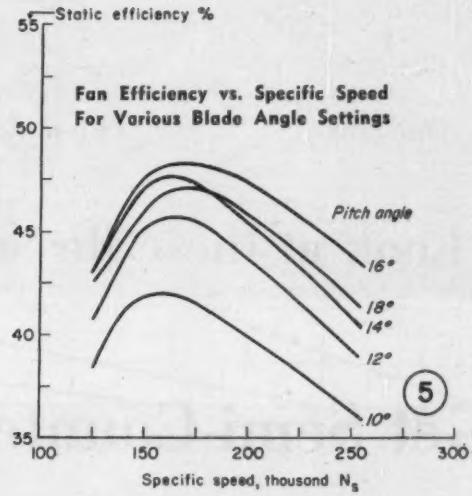
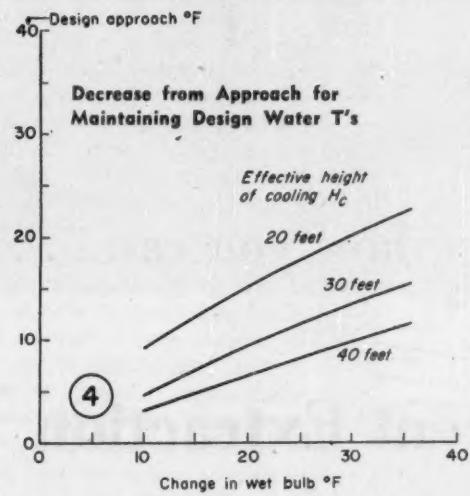
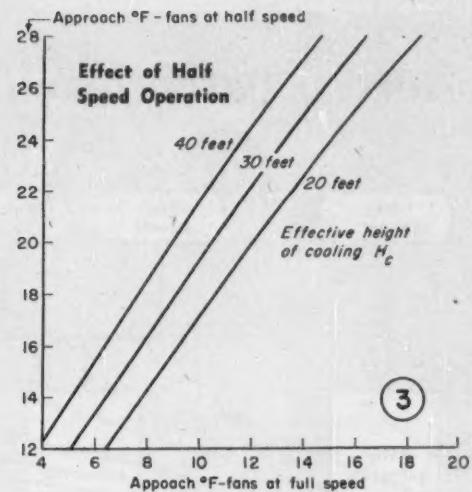
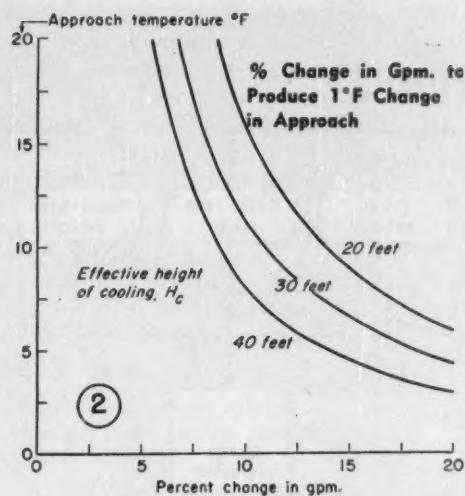
The cooling tower is a recirculating water cooler for the removal of waste industrial heat. The basic principle of operation, which is cooling by evaporation, is seemingly simple in design. The proper selection of equipment as well as operation techniques are, however, somewhat more involved than appear on the surface.

It is required that more useful estimating data as well as operating techniques be made more generally known. Close association between the purchaser and manufacturer will result in more nearly optimum selection and operation of this equipment.

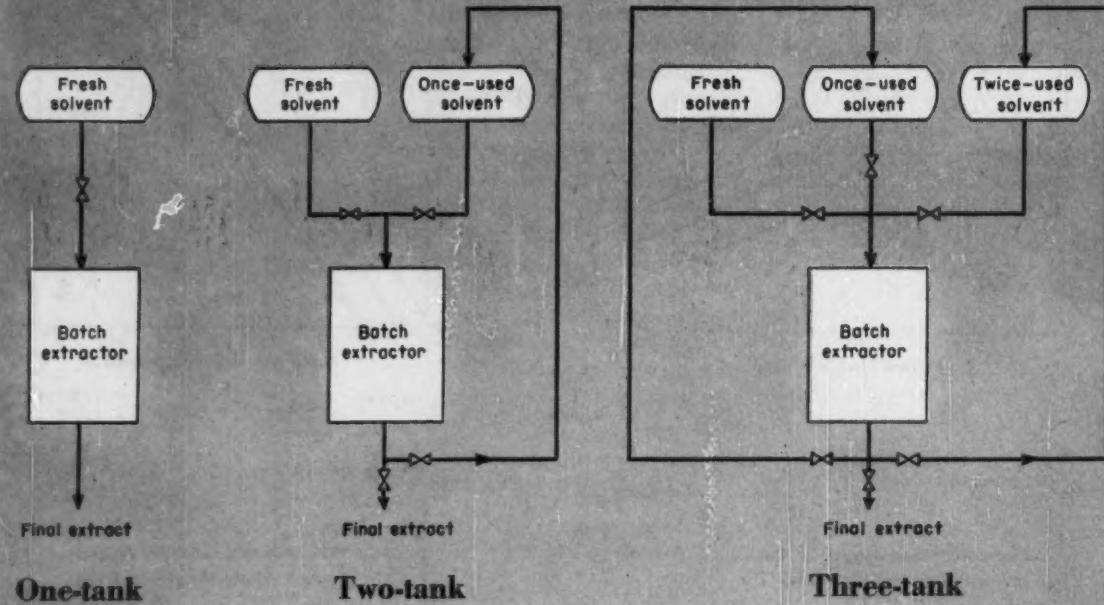
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... COOLING TOWERS



## Need a batch leaching system?



Look at these three and see how you can . . .

## Get Semi-Countercurrent Extraction

Many batch leaching problems do not justify either multiple fresh solvent contact or countercurrent methods. So here's a compromise for you: try partial countercurrency.

### GEORGE KARNOFSKY

In the usual textbook discussion of multistage batch liquid-solid extraction no means is described which is intermediate between multiple contact with fresh solvent and countercurrent

operation. Yet many extraction problems occur which for practical reasons are not well handled by either method.

For example, let's suppose you wish to extract nearly completely an impurity from 2,000 lb. a day of a finely divided solid.

So modest a capacity does not justify continuous countercurrent operation. The most practical equipment arrangement, then, consists of a single mixer or contactor, a basket centrifuge

or filter, and suitable tanks for solvent storage. The solids are slurried with solvent in the mixer, centrifuged and returned to the mixer for additional washes.

Your preliminary calculations will show that a number of extraction stages are required to accomplish the desired separation with a practical amount of solvent. The next step: how to best arrange these stages.

The simplest plan, but the most

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costly in the use of fresh solvent, employs multiple contacting with fresh solvent and requires only one tank to hold solvent. Countercurrent extraction, by which each batch would be washed with solutions of successively increasing concentration held over from the previous run, would cut down fresh solvent consumption. But it would require as many storage tanks as there are extraction stages and a complicated system of solvent handling.

#### A Happy Medium

Practically speaking, then, it would seem advantageous to employ partial countercurrent methods involving a number of tanks which is more than one but less than the number of stages. Equations are developed here which will indicate how an intermediate number of tanks can be justified.

The extraction methods proposed are similar in principle to true countercurrent operation—the product solution is last in contact with fresh solid feed and the extracted solids are last in contact with fresh solvent. But there is this difference: each batch is contacted more than once with each of the solutions of successively decreasing concentration held over in each tank from the preceding batch. In this manner a large number of washes may be used but the variety of solutions of different concentration used—and the number of tanks required to store them—is reduced.

Let  $m$  equal the number of tanks to be used (including the one for fresh solvent storage) and the number of times a solvent of different concentration will be employed to wash the batch.

Let  $n$  equal the number of times the solids will be contacted with a wash of a particular concentration before being contacted with a wash of lower concentration.

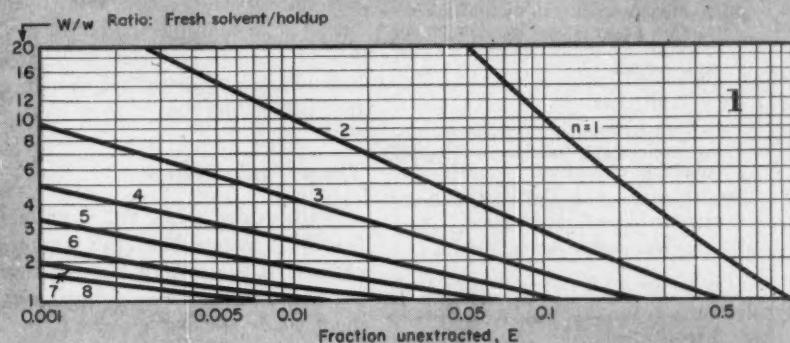
Then  $mn$  equals the total number of extraction stages to be used (the number of times the solids and solvent are to be mixed and separated).

#### One-Tank System

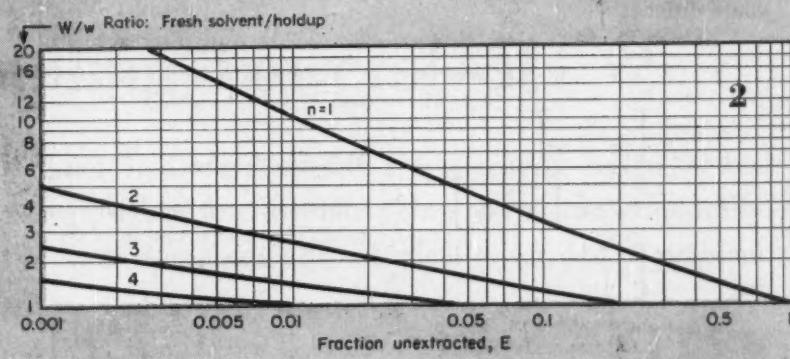
There is only one single tank system: multiple wash with fresh solvent. Although the calculation for this system is familiar it is instructive to

#### How many times ( $n$ ) do you need fresh solvent?

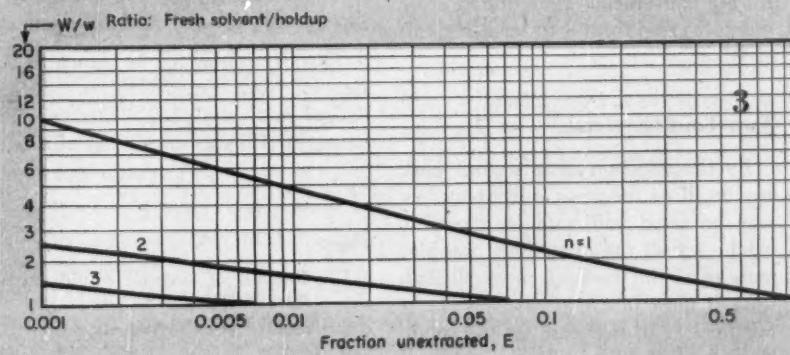
#### With one-tank system . . .



#### With two-tank system . . .



#### With three-tank system . . .



derive the equation by which the number of theoretical equilibrium stages is determined.

Let  $s$  = initial solute content, pounds absolute per pound of solute-free solids.

$w$  = solution holdup in drained solids leaving each extraction stage, cubic feet per pound of solute free solids

$W$  = solvent applied in each of  $m n$  extraction stages, cubic feet per pound of solute free solids ( $m n = n$  for one-tank system)

$$\alpha = w/(W + w)$$

$x$  = concentration of the solution leaving each stage, pounds solute per cubic foot of solution

$E$  = fraction of original solute still unextracted at end of process

Subscripts represent stage numbers

It is assumed for this derivation that all solute dissolves completely during the first contact with finely divided solids with solvent and that the only solute unrecovered after each separation is in the form of solution holdup.

For the first extract  $x_1 = s/W$

For the second extract, since all solute dissolves:

$$x_2 = \frac{x_1 w}{W + w} = \frac{s}{W} \left[ \frac{w}{W + w} \right]$$

$$x_n = \frac{s}{W} \left[ \frac{w}{W + w} \right]^{n-1}$$

$$E = \frac{x_n w}{s} = \frac{w}{W} \left[ \frac{w}{W + w} \right]^{n-1}$$

$$= \frac{W}{w} \left[ \alpha \right]^{n-1}$$

$$\frac{w}{W} = \frac{\alpha}{1 - \alpha}, \therefore E = \frac{\alpha^n}{1 - \alpha}$$

Fig. 1 was obtained by assuming values for  $n$  and alpha, substituting in the above expression, and plotting on log-log paper the calculated values for  $E$ . For convenience the ordinate scale was converted from  $\alpha$  to read in terms of  $W/w$ .

### Two-Tank System

By the addition of a second tank any or all of the fresh solvent washes may be saved and used on the next batch. Of all the operations possible, reuse of all the washes is most efficient since it most nearly approaches countercurrent. In that case let the solids be washed  $n^*$  times with a mixture of once-used solvent saved from the last batch, then with  $n$  washes of fresh solvent.

$$E = \frac{\alpha^{m^*}}{(1 - \alpha) \left[ 1 - \frac{\alpha(1 - \alpha^{m^*})}{n(1 - \alpha)} \right]}$$

Fig. 2 represents this relationship and was plotted similarly to Fig. 1. Comparison of Figs. 1 and 2 will demonstrate that in practically any case the two-tank system is more desirable than multiple wash with fresh solvent since it uses little more than half as much fresh solvent to achieve the same result.

### Three-Tank System

Many cycles can be visualized for a three-tank system but again the most efficient is the one that is the most nearly countercurrent. In this arrangement solids are first washed  $n$  times with a mixture of twice-used solvent, then  $n$  times with a mixture of once-used solvent, then  $n$  times with fresh solvent.

$$E = \frac{\alpha^{m^*}}{(1 - \alpha) \left[ 1 - \frac{\alpha(1 - \alpha^{m^*})}{n(1 - \alpha)} \right]^2}$$

Fig. 3 was obtained as were Figs. 1 and 2.

### M-Tank System

Although of doubtful practical value, the general case for a system of  $m$  tanks will be recognized as

$$E = \frac{\alpha^{m^*}}{(1 - \alpha) \left[ 1 - \frac{\alpha(1 - \alpha^{m^*})}{n(1 - \alpha)} \right]^{m-1}}$$

Substituting  $n = 1$  gives the equation for fully countercurrent extraction with  $m$  stages,

$$E = \left( \frac{\alpha}{1 - \alpha} \right)^m = \left( \frac{w}{W} \right)^m$$

This expression can be shown to be identical with Eq. (271), p. 426 in Badger and McCabe's "Elements of Chemical Engineering," 2nd edition:

$$F = \frac{1}{1 + a_m(1 + a + a^2 + \dots + a^{m-1})}$$

where

$$F = \text{fraction of original solute unextracted (equal to our } E)$$

$$m = \text{number of extraction steps}$$

\* $n$ , it should be remembered, will be different for each system. If  $T$  is the total number of extraction stages (washings to be given), then  $n = T/m$ . Hence, for the one-tank system,  $n$  equals  $T/1$ ; for the two-tank system,  $n$  equals  $T/2$ , etc.

$a = W/w$  (constant for all stages save the last, or  $n$ th, stage)

when

$$a_m = (W - w)/w = a - 1$$

Now

$$F = \frac{1}{1 + \frac{(a - 1)(1 - a^m)}{1 - a}} = \frac{1}{a^m}$$

$$a = \frac{1}{\alpha} - 1 \quad \therefore F = \left( \frac{\alpha}{1 - \alpha} \right)^m = E$$

### Example Problem

It is desired to remove 99.7% of an impurity from a granular solid by batch extraction using a total of six ( $T$ ) washes. What are the relative amounts of fresh solvent that will be required by one-, two- and three-tank systems and by countercurrent treatment?

The ratio of solvent applied in each washing operation to the solution holdup is  $W/w$ . This ratio is particularly significant in that it also represents the ratio of fresh solvent applied  $n$  times to the holdup liquor. Therefore  $nW/w$  equals the relative volume of fresh solvent required in each system to achieve the same degree of solute extraction. Values for  $W/w$  in the table were read from Figs. 1, 2 and 3.  $W/w$  for countercurrent operation was calculated.

| System                        | $\theta/m$ | $W/w$ | Fresh Solvent ( $nW/w$ ) |
|-------------------------------|------------|-------|--------------------------|
| One-tank                      | 6          | 1.8   | 10.8                     |
| Two-tank                      | 3          | 1.9   | 5.7                      |
| Three-tank                    | 2          | 2.05  | 4.1                      |
| Countercurrent<br>( $m = 6$ ) | 1          | 2.6   | 2.6                      |

### Strike a Balance

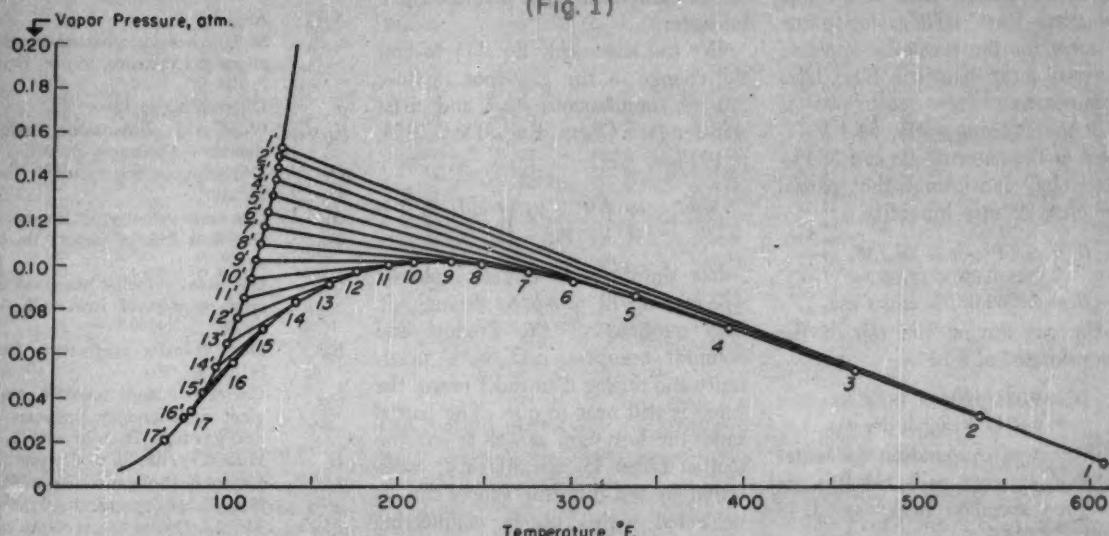
In this example it is apparent that the one-tank system is wasteful of solvent and difficult to justify. Choice between the two- and three-tank plans can be determined by a study of cost of a tank versus cost of recovering the additional fresh solvent necessary for each batch. Should the solute itself be a desirable product another factor appears in favor of three tanks over one or two tanks: the smaller volume of extract produced (at higher concentration, of course) for the same amount of solute extracted may make subsequent solute recovery less costly. The three tank system approaches ideal countercurrent operation in its use of solvent and a more complex arrangement would probably not be in order.

194

January 1955—CHEMICAL ENGINEERING

### Graphical Solution Finds Intermediate Points

(Fig. 1)



**HOW TO . . .**

## Design Gas-Cooling Towers—II

Part I, in December, gave a new general design method for gas-cooling towers in which intermediate points are found graphically. Here the method is applied to a typical tower design problem.

### G. H. P. BRAS

In the first part of this article (Dec. 1954, p. 191) we discussed the development of a general design method for gas-cooling towers which operates successfully when simultaneous heat transfer and humidification or dehumidification take place. The method is largely graphical. As far as we know, it is the only method proposed, thus far, by which temperatures and partial vapor pressures at intermediate points in the tower can be calculated.

The method applies to the design of other equipment where simultaneous heat and mass transfer occur. Part I developed the necessary mathematical

expressions, that allow a graphical point-to-point determination of the temperature and partial vapor pressure of the gas vapor mixture as it passes through the tower.

Usually 15 to 20 points on the *t-p* diagram are required. Finally, by calculating the quantity of heat transferred in each step, we can apply a graphical integration to find the total packing area and volume required.

#### PRODUCER GAS COOLER

**Problem**—Producer gas enters a scrubber-cooler at 608 F. with a partial vapor pressure of 0.01 atm. and at 1 atm. total pressure. The gas is to be cooled to 80 F. and is supposed to leave the top of the tower at this temperature.

Cooling water enters the tower at 64.4 F. and is assumed to leave near

the wet-bulb temperature of the entering gases, at 130 F. The composition of the producer gas is:

|                 |       |
|-----------------|-------|
| Nitrogen        | 57.2% |
| Carbon monoxide | 26.9% |
| Carbon dioxide  | 5.0%  |
| Oxygen          | 1.0%  |
| Hydrogen        | 9.3%  |
| Methane         | 0.6%  |

The calculated molecular weight is 26.34 and the average specific heat calculated at the average gas temperature (344 F.) is 0.271 Btu./lb.-°F.

We want to design a cooling tower to handle 14,000 lb. of gas per hr. specifying the packing area necessary for simultaneous heat and mass transfer. The tower will be packed with wood grid. Slats are 0.75 by 6 in. with 3.75 in. clearance between the slats. In each hurdle, slats are set at right angles to those in the next hurdle.

G. H. P. BRAS is a chemical engineer with Chemical Construction (Inter-American) Ltd. in Toronto. Last month he developed the method, now he shows it in use.

## GAS-COOLING TOWERS . . .

Cooling water is sprayed into the tower by spray heads fixed at the top.

**Solution**—First we'll calculate the L/G ratio for the tower by applying an over-all heat balance. Base level of temperature (zero enthalpy) is that of the entering water, 64.4 F.

Heat of the entering gas can be calculated by converting the partial vapor pressure into humidity.

$$H = p_v / (P - p_v) \cdot M_v / M_w \\ = 0.01 / 0.99 \times 18 / 26.34 \\ H = 0.0069 \text{ lb./lb. of dry gas}$$

For the gas leaving the top of the tower saturated at 80 F.,

$$H = 0.034 / 0.966 \times 18 / 26.34 \\ = 0.0243 \text{ lb./lb. of dry gas}$$

The heat of evaporation for water at 64.4 F. is taken as 1,054 Btu./lb. and the specific heat as 0.48 Btu./lb.-°F.

For each pound of dry entering gas the heat is:

$$(608 - 64.4)(0.271) = 147.32 \text{ Btu.} \\ 0.0069(1,054) = 7.28 \\ 0.0069(0.48)(608 - 64.4) = 1.79$$

$$\text{Total } 156.39 \text{ Btu.}$$

For each pound of dry gas leaving the heat is:

$$(80 - 64.4)(0.271) = 4.23 \text{ Btu.} \\ 0.0243(1,054) = 25.62 \\ 0.0243(0.48)(80 - 64.4) = 0.18$$

$$\text{Total } 30.03 \text{ Btu.}$$

Therefore, the heat transferred to the water is 126.4 Btu./lb. of dry gas.

If we now assume that the ratio L/G is equal to  $x$  at the top of the tower, this equation must hold:

$$(x - 0.0243 + 0.0069) \cdot (130 - 64.4) = 126.4 \text{ Btu./lb.} \\ (x - 0.0174)65.6 = 126.4 \\ x = 1.947$$

By a similar heat balance we find that, for the bottom of the tower, L/G = 1.930. The difference in flow ratio is due to the evaporation of water carried out of the tower with the gas.

### CALCULATING INTERMEDIATE POINTS

Next, we'll calculate temperatures and vapor pressures at intermediate points in the tower. On the temperature-vapor pressure diagram, Fig. 1, point 1 represents the condition of the entering gas at the bottom of the tower (608 F., 0.01 atm.). Point 1' represents the leaving cooling water at the bottom of the tower. The temper-

ature is 130 F. and the point is located on the saturation vapor pressure curve for water.

We can now apply Eq. (1) to find the change in the gas-vapor mixture due to simultaneous heat and mass transfer (see *Chem. Eng.*, Dec. 1954, p. 191).

$$\frac{dp}{dt} = \frac{\Delta p}{\Delta t} \left( \frac{P - p_v}{p_{v1}} \right) \left( \frac{c_p D_v}{k} \right)^{1/2}$$

For simplicity in this example we will take  $dp/dt = \Delta p/\Delta t$  throughout. The quotient of the Prandtl and Schmidt numbers,  $c_p D_v/k$ , is nearly unity and raising it to the  $\frac{1}{2}$  power the value is still near to one. The partial vapor pressure term as well as any correction factor for sensible heat transferred by the diffusing vapors can be neglected in this case for engineering calculations (see later discussion). Thus, we can connect points 1 and 1' with a straight line.

The line represents the trend in the initial change of the gas-vapor mixture due to simultaneous heat and mass transfer; it may be followed for a short distance only. This gives us point 2. From the diagram, at point 2,  $t_2 = 536$  F. and  $p_v = 0.0316$  atm. Calculated humidity then is 0.02227.

The heat content of the gas-vapor mixture at point 2 is:

$$0.0271(536 - 64.4) = 127.81 \text{ Btu./lb.} \\ 0.02227[1,054 + 0.48(471.6)] = 28.52$$

$$\text{Total } 156.33 \text{ Btu./lb.}$$

We can now get the flow ratio at point 2. It is the ratio at the bottom plus the humidity at point 2 less the humidity of the entering gas.  $L/G = 1.930 + 0.02227 - 0.0069 = 1.945$ . Then by a heat balance we find the temperature of the cooling water

$$1.930(130 - 64.4) - 1.945(t_w - 64.4) = 156.38 - 156.33 = 0.05 \\ t_w = 129.38 \text{ F.}$$

If we now connect point 2 and 2' by a straight line we may use this line for a short distance and arrive at point 3. We repeat the procedure until we reach the top of the tower. The results of the graphical step-by-step calculations are shown in the table above. Values are plotted on a partial vapor pressure temperature diagram in Fig. 1. Here we see that humidification occurs from the bottom

### Nomenclature

|  |   |
|--|---|
| <b>A</b>   | Area, sq. ft.   |
| <b>c, c<sub>v</sub></b>                            | Specific heat at constant pressure vapor-gas mixture, vapor, Btu./lb.-°F.   |
| <b>d</b>   | Differential operator   |
| <b>d<sub>x</sub>, d<sub>y</sub>, d<sub>z</sub></b> | Wood-grid dimensions, height, clearance, thickness, ft.   |
| <b>D<sub>v</sub></b>                               | Diffusion coefficient, sq. ft./hr. 2.7183   |
| <b>e</b>   | Gas mass velocity, lb./hr.-sq. ft.  |
| <b>G</b>   | Gas flow free of vapor, lb./hr.-sq. ft.   |
| <b>G'</b>  | Gas mass velocity based on free cross section of tower, lb./hr.-sq. ft.   |
| <b>h<sub>g</sub></b>                               | Heat transfer coefficient, Btu./hr.-sq. ft.-°F.   |
| <b>h<sub>gs</sub></b>                              | Corrected heat transfer coefficient at boundary between gas and gas film, Btu./hr.-sq. ft.-°F.  |
| <b>H</b>   | Humidity, lb./lb. of dry gas  |
| <b>i<sub>g</sub>'</b>                              | Latent heat of gas-vapor mixture, Btu./lb. of dry gas   |
| <b>i<sub>g</sub></b>                               | Total enthalpy of gas-vapor mixture, Btu./lb. of dry gas  |
| <b>j'</b>  | Heat transfer factor based on free cross section of tower, dimensionless  |
| <b>k</b>   | Heat conductivity of gas, Btu./hr.-sq. ft.-°F.  |
| <b>L</b>   | Liquid mass velocity, lb./hr.-sq. ft.   |
| <b>L'</b>  | Liquid mass velocity based on free cross section of tower, lb./hr.-sq. ft.  |
| <b>M<sub>m</sub>, M<sub>v</sub></b>                | Molecular weight of gas-vapor mixture, of vapor, lb./lb.-mole   |
| <b>P</b>   | Partial vapor pressure, atm.  |
| <b>P<sub>0</sub></b>                               | Partial vapor pressure of inert gas at main body of gas-vapor mixture, atm.   |
| <b>P<sub>ef</sub></b>                              | Logarithmic mean partial pressure of the inert in the gas film, atm.  |
| <b>P<sub>f</sub>, P<sub>s</sub></b>                | Partial pressure of vapor at the interface, in the main body of the gas-vapor mixture, atm.   |
| <b>P<sub>w</sub></b>                               | Partial vapor pressure of cooling liquid, atm. ( $= p_s$ )  |
| <b>Δp</b>  | $p_i - p_g$ , atm.  |
| <b>P</b>   | Total pressure, atm.  |
| <b>q</b>   | Sensible heat content of gas-vapor mixture, Btu./lb. of dry gas   |
| <b>Q</b>   | Heat transferred, Btu./hr.-sq. ft.  |
| <b>t</b>   | Temperature, deg. F.  |
| <b>t<sub>1</sub>, t<sub>2</sub></b>                | Temperature at gas-liquid interface, at boundary between gas film and main body of gas stream, Btu./hr.-sq. ft.   |
| <b>t<sub>w</sub></b>                               | Temperature of cooling liquid, °F.  |
| <b>Δt</b>  | $t_i - t_p$ , °F.   |
| <b>Δt<sub>m</sub></b>                              | Logarithmic mean temperature difference through gas film, °F.   |
| <b>μ</b>   | Ratio between heat transfer coefficient for the sensible heat transferred by the diffusing vapors and convective heat transfer coefficient, dimensionless |
| <b>ρ</b>   | Viscosity, lb./hr.-ft.  |
| <b>ρ</b>   | Density of gas-vapor mixture, lb./cu. ft.   |

## Calculation of Intermediate Points in a Gas-Cooling Tower Design

| Point | $t_g$ , °F. | $P_g$ , atm. | $H_g$ , lb./lb. | $i_g''$ , Btu./lb. | $\Delta i_g''$ , Btu./lb. | $L/G$ | $t_{\text{av}}$ , °F. | $p_{\text{av}}$ , atm. | $i_g'$ , Btu./lb. | $Btu./lb.$ | $q$   | $-\Delta t$ , °F. | $-1/\Delta t$ , °F. |
|-------|-------------|--------------|-----------------|--------------------|---------------------------|-------|-----------------------|------------------------|-------------------|------------|-------|-------------------|---------------------|
| 1     | 608         | 0.0100       | 0.0069          | 156.38             | .....                     | 1.930 | 129.9                 | 0.1509                 | 7.27              | 149.11     | 479.1 | 0.00209           |                     |
| 2     | 536         | 0.0316       | 0.0223          | 156.33             | 0.05                      | 1.945 | 129.4                 | 0.1488                 | 23.49             | 132.84     | 406.6 | 0.00246           |                     |
| 3     | 464         | 0.0522       | 0.0376          | 155.14             | 1.24                      | 1.961 | 128.2                 | 0.1442                 | 39.65             | 115.49     | 334.0 | 0.00298           |                     |
| 4     | 392         | 0.0718       | 0.0528          | 152.75             | 3.63                      | 1.976 | 126.5                 | 0.1377                 | 55.67             | 97.08      | 263.8 | 0.00378           |                     |
| 5     | 338         | 0.0850       | 0.0635          | 149.44             | 6.94                      | 1.987 | 124.5                 | 0.1305                 | 66.96             | 82.84      | 213.5 | 0.00470           |                     |
| 6     | 302         | 0.0925       | 0.0696          | 145.71             | 10.67                     | 1.998 | 122.4                 | 0.1233                 | 73.39             | 72.32      | 179.6 | 0.00556           |                     |
| 7     | 275         | 0.0971       | 0.0735          | 142.02             | 14.36                     | 1.997 | 120.5                 | 0.1167                 | 77.40             | 64.62      | 154.5 | 0.00646           |                     |
| 8     | 248         | 0.1004       | 0.0763          | 136.94             | 19.44                     | 1.999 | 117.9                 | 0.1088                 | 80.46             | 56.48      | 130.1 | 0.00770           |                     |
| 9     | 230         | 0.1013       | 0.0770          | 132.17             | 24.21                     | 2.000 | 115.5                 | 0.1016                 | 81.20             | 50.97      | 114.5 | 0.00874           |                     |
| 10    | 212         | 0.1013       | 0.0770          | 126.65             | 29.73                     | 2.000 | 112.7                 | 0.0939                 | 81.20             | 45.45      | 99.3  | 0.01008           |                     |
| 11    | 194         | 0.1000       | 0.0759          | 119.86             | 36.52                     | 1.999 | 109.4                 | 0.0853                 | 80.03             | 39.83      | 84.6  | 0.01182           |                     |
| 12    | 176         | 0.0970       | 0.0734          | 111.54             | 44.84                     | 1.997 | 105.3                 | 0.0756                 | 77.40             | 34.14      | 70.7  | 0.01414           |                     |
| 13    | 158         | 0.0912       | 0.0685          | 100.69             | 55.69                     | 1.992 | 99.9                  | 0.0644                 | 72.23             | 28.46      | 58.1  | 0.01720           |                     |
| 14    | 140         | 0.0830       | 0.0618          | 87.89              | 68.49                     | 1.985 | 93.7                  | 0.0531                 | 65.16             | 22.73      | 46.4  | 0.0216            |                     |
| 15    | 122         | 0.0714       | 0.0525          | 72.41              | 83.97                     | 1.976 | 85.9                  | 0.0418                 | 55.35             | 17.06      | 36.1  | 0.0277            |                     |
| 16    | 104         | 0.0565       | 0.0409          | 54.63              | 101.75                    | 1.964 | 77.0                  | 0.0313                 | 43.13             | 11.50      | 27    | 0.0370            |                     |
| 17    | 80          | 0.0344       | 0.0243          | 29.97              | 126.41                    | 1.947 | 64.4                  | 0.0204                 | 25.61             | 4.36       | 15.6  | 0.0642            |                     |

of the tower until a point has been reached where the temperature is about 230 F.

Further cooling of the gas from this temperature to 80 F. at the top of the tower takes place under simultaneous dehumidification.

In column 10 of the table, values of  $i_g' = 1,054$  H have been added, while in column 11, values of  $q = i_g'' - i_g'$  are shown. The value of  $i_g'$  represents the latent heat of the vapor contained in the gas, calculated at the temperature of the gas. Thus, values of  $q$  represent the true sensible heat content of the gas-vapor mixture calculated from the reference level.

## CALCULATING PACKING AREA

We can find the area of the packing required by a graphical integration of Eq. (24). In this case we can assume that  $h_g$  is substantially constant between the bottom and top of the tower, due to the nearly constant gas and liquid rates.

Thus, Eq. (24) reduces to a form where  $h_g$  is replaced by  $h_g$ ,

$$A = \int dA = \frac{G_o}{h_g} \int \frac{dq}{\Delta t}$$

For carrying out the graphical integration, values of  $q$  have been plotted against values of  $1/\Delta t$  (see the table above). The result is the curve shown in Fig. 2. The area under the curve, measured from the zero ordinate represents the value of the integral.

This area can be found either by measuring or by calculation and is equal to 1.524 Btu./lb.-°F. The packing area required for the tower is

$$A = (14,000/h_g)1.524 = 21,335/h_g$$

Now we can compare this value

with that calculated with a logarithmic mean temperature difference (as done by Furnas and Newton<sup>7</sup>).

$$A = Q/h_g \Delta t_m$$

The total sensible heat transferred from the gas to the cooling water, neglecting humidification and dehumidification in the tower, is equal to  $0.271 (608-80) (14,000) = 2,003,000$  Btu/hr.

The logarithmic mean temperature difference between the bottom and the top of the tower equals  $\Delta t_m = 135$  °F. Therefore,

$$A = 2,003,000/135h_g = 14,840/h_g$$

There is a difference of about 44% with the older method giving the lower figure. It should be understood that considerably greater differences may be encountered in other cases.

## TOWER DIMENSIONS

We will assume a square tower construction  $5.25 \times 5.25$  ft. with a cross section of 27.6 sq. ft. The gas mass velocity would be  $14,000/27.6 = 507$  lb./hr.-sq. ft., and the liquid mass velocity will be taken at an average of twice this amount or  $L = 1,014$  lb./hr.-sq. ft. These figures are based on the cross section of the tower.

The free cross section of the wood-grid packing is 83.3% of the total tower cross section. So the corrected mass velocities are  $G' = 607$  and  $L' = 1,220$  lb./hr.-sq. ft. Now we can apply Johnstone and Singh's formula<sup>8</sup> for wood-grid packing

$$j' = 0.035 \left( \frac{d_g G'}{\mu} \right)^{-0.2} + 0.053 \left( \frac{d_g^2}{d_g d_g} \right)^{0.4}$$

$$= 0.035 \left( \frac{0.312 \times 607}{0.057} \right)^{-0.2} +$$

$$0.053 \left( \frac{0.0039}{0.312 \times 0.5} \right)^{0.4}$$

$$j' = 0.0069 + 0.0121 = 0.0190$$

The heat transfer coefficient can be calculated from

$$h_g = j' c G' / (c \mu / k)^{2/3}$$

At the average temperature in the tower (344 F.), the value of  $c \mu / k$  is  $(0.271)(0.057)/0.0302 = 0.511$ . Raising this to the  $2/3$  power gives 0.64. Therefore,

$$h_g = 0.0190(0.271)(607)/0.64$$

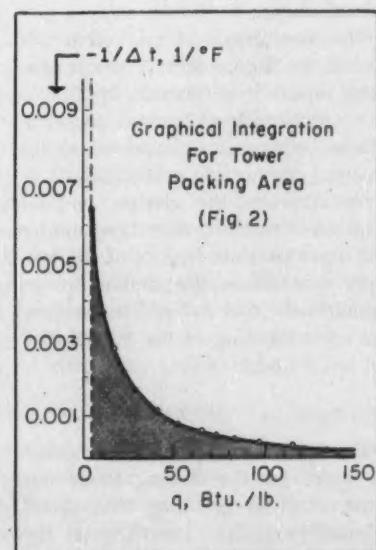
$$h_g = 4.9 \text{ Btu./hr.-sq. ft.-°F.}$$

And the required area of the packing is

$$A = 21,335/h_g = 21,335/4.9$$

$$A = 4,325 \text{ sq. ft.}$$

We can also calculate that the tower contains about 6 sq. ft. of packing area per cu. ft. of volume. Hence, the tower packing volume required is 725



## GAS-COOLING TOWERS . . .

### Correction Factors at Some Intermediate Points

| Point in Tower | $P - p_v$<br>atm. | $p_{ef}$<br>atm. | $\ln \frac{(P - p_v)}{(P - p_e)}$ | $e^e$   | $\frac{P - p_v}{p_{ef}}$ | $\frac{e^e - 1}{ee^e}$      |
|----------------|-------------------|------------------|-----------------------------------|---------|--------------------------|-----------------------------|
| 1              | 0.990             | 0.918            | 0.1534                            | 0.1856  | 1.2040                   | $1.078 \times 0.913 = 0.98$ |
| 3              | 0.948             | 0.902            | 0.1021                            | 0.1236  | 1.1315                   | $1.050 \times 0.942 = 0.99$ |
| 8              | 0.900             | 0.897            | 0.0094                            | 0.0113  | 1.0114                   | $1.0 \times 1.0 = 1.00$     |
| 12             | 0.903             | 0.913            | -0.0234                           | -0.0284 | 0.972                    | $0.990 \times 1.015 = 1.01$ |
| 16             | 0.944             | 0.957            | -0.0264                           | -0.0319 | 0.968                    | $0.987 \times 1.037 = 1.02$ |

cu. ft. and the height of the cooling tower is  $725/27.6 = 26.2$  ft.

### DIMENSIONS—FURNAS' METHOD

For comparison we will now calculate the dimensions of the tower using the method proposed by Furnas and Newton.<sup>7</sup> Note that the grid packing chosen for the tower has the same dimensions and spacing as that on which the Furnas-Newton data are based. Therefore, by using their proposed equation for the heat transfer coefficient of producer gas

$$H_v = 21W + 14G^{0.4}$$

where  $H_v$  = Btu./hr.-cu. ft.-°F.;  $W$  = lb. of water/sec.-sq. ft.; and  $G$  = lb. of gas/sec.-sq. ft.,

$$H_v = 12.40 \text{ Btu./hr.-cu. ft.-°F.}$$

Using their length equation the tower is about 49 ft. high.

We should note though, that although the tower packing in Furnas' and Newton's experiments was the same as that assumed in our calculations, the experimental tower was only  $\frac{1}{2}$ -filled with packing, due to the spacing of each set of packing hurdles. So, the actual packed height of the experimental tower would amount to about 16 ft. against the 26 ft. calculated above.

This new graphical method is not limited to the system producer gas-water vapor. It is generally applicable to a wide variety of systems and conditions because it is based on sound chemical engineering principles.

In addition the design method helps in visualizing the temperature and vapor pressure history of the gas-vapor mixture in the cooling tower. Undoubtedly this will add to the general understanding of the behavior of the tower under varying conditions.

### DISCUSSION

The temperature-partial vapor pressure curve for the cooling tower was constructed by assuming that  $dp/dt$  is equal to  $\Delta p/\Delta t$ . This neglects the

groups  $(P - p_v)/p_{ef}$ ,  $(c_p D_v/k)^{0.5}$  and  $(e^e - 1)/ee^e$ . In the table above we have calculated some values for these groups at several points in the tower.

The product of the two groups  $(P - p_v)/p_{ef}$  and  $(e^e - 1)/ee^e$  is given in the last column of the table. We can see that they, in effect, neutralize each other. So it is entirely justified to neglect them here.

For calculation of  $e^e$ , we used Eq. (17) and took  $c_v M_v/cM_m$  as equal to 1.210 for all cases, while the group  $(c_p D_v/k)^{0.5}$  was assumed to be equal to unity. This last assumption is somewhat uncertain, due to the lack of a reliable figure for  $D_v$ . We believe, however, that the error involved is negligible in comparison with the accuracy of the available heat and mass transfer coefficients for towers.

In calculating the cooling tower we used Johnstone and Singh's heat and mass transfer coefficient for wood-grid based on experiments at normal temperature. The heat transfer coefficient was evaluated at the average gas temperature, 344 F., by using estimated values for the specific heat and viscosity at that temperature.

Actually the heat transfer coefficient is not constant in the tower. The temperatures change from point to point and so does the gas mass velocity. The coefficient increases at higher temperatures because of the effect of increased heat conductivity, not quite counter-balanced by increased viscosity.

Since most of the packing is required at the cold end of the tower, (see Fig. 2), the heat transfer coefficient calculated at the average tower temperature is on the safe side. It is generally agreed that Johnstone and Singh's<sup>8</sup> coefficients are high.

We have neglected the liquid film resistance for heat transfer. This agrees with observations by Johnstone and Singh. They found little effect of the liquid rate on mass transfer coefficient at liquid velocities above

40.95 lb./hr.-ft. of wetted perimeter. It should be understood that at these liquid rates the packing was completely wetted.

The minimum liquid rate at which uniform liquid film could be maintained on the wood-grids was found to be approximately 22.5 lb./hr.-ft. of wetted perimeter.<sup>9</sup> In our design example the liquid rate is about 190 lb./hr.-ft. of wetted perimeter. Let us add that at the present time there is no pertinent information available for the magnitude of liquid film effect in gas-cooling towers as they are normally operated.

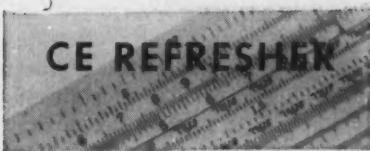
For determining the packing area required for the cooling tower, we calculated a heat transfer coefficient at the average tower temperature. No correction was made for the sensible heat transferred by the diffusing vapors. We can see from the table above that the corrected heat transfer coefficient,  $h_{eff} = h_e(ee^e)/(e^e - 1)$ , is greater at the hot end but smaller at the cold end of the tower.

The deviation is greatest at the hot end, 8.7%, against 3.7% at the cold end—where most of the packing area is required in this example. It seems reasonable to neglect this effect for most engineering calculations.

On the whole, the new design method presented here is quite simple to handle for all towers where the same general conditions prevail as in our worked-out example. This is especially true if the tower has to handle air-water vapor mixtures or systems for which the quotient of the Schmidt-Prandtl ratio,  $c_p D_v/k$ , is near to unity.

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# Chemical Engineering Fundamentals

## Catalytic Vapor Phase Reactions—I

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In the two sections on catalysis and adsorption (*Chem. Eng.*, Nov. 1954, p. 236 and Dec. 1954, p. 198) we discussed the possible ways by which a gas may be adsorbed upon a solid surface. We also showed the relationship between the adsorption mechanism and the equilibrium adsorption equation. In this installment we'll see how these adsorption equations fit into catalytic kinetics.

Also, we will show how the rate equation for a catalytic reaction is determined by the mechanism of the reaction.

### Applying Adsorption to Catalysis

When a gas phase chemical reaction is promoted by a solid catalyst, it has to be accompanied by adsorption. The reactants are adsorbed; the products are formed in an adsorbed condition and must be desorbed. If there were no adsorption there would be no catalysis.

As more knowledge is obtained on the fundamentals of the adsorption phenomena, the greater will be our understanding of catalysis and reaction kinetics on catalytic surfaces. We now believe that the type of adsorption that plays the major role in catalysis is chemical adsorption.

Therefore, the steps involving adsorption and desorption in a catalytic reaction are classified along with the surface reaction as chemical steps. The adsorption step of a catalytic reaction is just like any other chemisorption process. The adsorption reactions and equations that we discussed last month are applicable to the adsorption and desorption steps of the catalytic reaction.

The type of adsorption reaction that takes place between each reactant and the catalyst—or would take place between each product and the catalyst were the products being adsorbed—has an important bearing on the over-all mechanism of a reaction. Therefore, in developing equations to represent catalytic processes, we should include terms that show the effect of adsorption of the individual components on the catalyst surface.

There have been attempts to correlate the rate of a catalytic reaction with equations similar to those used for homogeneous reactions—equations that do not pro-

vide for the adsorption terms and which assume an "order of reaction" upon the catalyst surface. In many cases these correlations were unsuccessful because the reaction rate constant was found to vary with composition and pressure.

It is now realized that a reliable rate equation for a catalytic reaction must contain terms which will account for the relative adsorptivity of the catalyst toward each of the components in the gas stream. The "order of reaction" concept, which may be used to explain the behavior of homogeneous reactions, falls far short of providing a reliable rate equation that truly represents a catalytic process.

### Development of Catalytic Rate Equations

The chemical engineer's interest in kinetics is generally from the point of view of its application to reactor design. To him a rate equation for a chemical reaction is satisfactory as long as it is reliable over a wide range of conditions—so that it may be applied with confidence to calculations on a large-scale reactor.

His interest in the rate equation as a means of gaining insight as to the mechanism of the reaction is usually secondary. However, if the experimental data from laboratory or pilot plant studies can be presented in a manner based on a theoretical correlation, they are useful not only for design calculations but also may give the process engineer some insight into the factors that affect the rate of the reaction.

A rate equation for a catalytic reaction has more chance of representing the true reaction conditions if it includes terms representing the adsorption of reactants and products on the catalyst surface. Equations of this type are presented in the two outstanding text books on this subject.<sup>1, 2</sup>

### Basis of Catalytic Rate Equations

The rate equations are based upon the seven steps that a vapor phase catalytic reaction goes through. These were listed earlier but we'll repeat them here for your convenience: 1. Diffusion of the reactant to the surface of the catalyst; 2. Diffusion into the pores of

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the catalyst; 3. Adsorption of the reactant on to the catalyst surface; 4. The actual chemical reaction or series of reactions that take place in the adsorbed phase on the catalyst surface; 5. Desorption of product molecules; 6. Diffusion of the products to the exterior of the catalyst pellet; 7. Diffusion from the pellet to the main gas stream.

Of these steps, 1, 2, 6 and 7 are purely physical steps. Steps 3, 4 and 5 are chemical steps (including chemisorption).

Equations have been derived for cases where chemical steps (adsorption, surface reaction and desorption) are the only rate-determining ones. These equations are applicable to the cases where steps 1, 2, 6 and 7 (the physical steps of film diffusion and pore diffusion to and from the catalyst) are rapid enough so that they do not at any time affect the over-all reaction rate.

The equations assume that there is actual chemical combination between the reactants and the active center, and that the active center behaves as a chain carrier. The role of the active center in the catalytic reaction is very similar to that of the free radical in the homogeneous reaction.

### How to Derive the Rate Equation

To derive a rate equation, first write a chemical equation for each step. Then assume that since all the steps are in series, the slowest controls the rate. The rate of the over-all reaction would be equal to that of the slowest step and all the rest of the steps would automatically be at equilibrium.

Next write an equation for the rate of the slow step in terms of the concentrations of adsorbed materials, empty active centers and partial pressures of the gases at the interface between gas and catalyst. If diffusion is negligible, the partial pressure at the catalyst surface is the same as in the main gas stream. Then eliminate the terms that contain concentration of active centers or adsorbed molecules (since these cannot be measured directly).

Here's a specific example of the derivation of a rate equation. Let's suppose the reaction of A going reversibly to R and S takes place by the following steps:

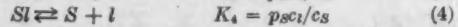
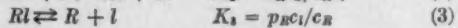
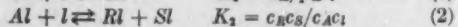
1. A molecule of A is adsorbed upon an active center on the catalyst.

2. The adsorbed molecule of A then reacts with a nearby active center to form R and S.

### Nomenclature (Consistent units)

|             |   |
|-------------|---|
| <i>A, B</i> | Reactants                                       |
| <i>c</i>    | Concentration of adsorbed gas                   |
| <i>k</i>    | Rate constant, forward reaction                 |
| <i>k'</i>   | Rate constant, reverse reaction                 |
| <i>K</i>    | Equilibrium constant                            |
| <i>I</i>    | An active center                                |
| <i>L</i>    | Total effective concentration of active centers |
| <i>p</i>    | Equilibrium partial pressure of adsorbent gas   |
| <i>r</i>    | Reaction rate                                   |
| <i>R, S</i> | Products  |

3. *R* and *S* are then desorbed into the main gas stream. Using the conventional symbol, *I*, to designate an empty active center, we can write the chemical equations for these steps.



In these equations  $K_1$ ,  $K_2$ ,  $K_3$  and  $K_4$  represent the equilibrium constants for the individual steps;  $c_A$ ,  $c_S$  and  $c_I$  are the concentrations of the adsorbed gases; and  $c_I$  is the concentration of empty active centers. If any one of the above steps is slower than the rest it will be the rate-controlling step. The final form of the rate equation will depend upon which of the steps is the slow one. Let's choose as an example the case where step 1, the adsorption step, is the slow one. The rate of step 1 would be equal to the rate of the over-all reaction. The rest of the steps would be at equilibrium.

If we assume each step to be of simple order, the rate equation for step 1 is:

$$r = k_1 p_{AC_I} - k'_1 c_A \quad (5)$$

where  $k_1$  and  $k'_1$  may be regarded as forward and reverse rate constants of step 1. The equation is merely the application of mass action to the adsorption reaction. Writing  $k_1 p_A c_I$  for the forward rate is really the same as assuming that the adsorption reaction is a second order reaction in which the active center,  $I$ , is used as the second reactant. Writing  $k'_1 c_A$  for the reverse reaction assumes that the rate of desorption of  $A$  is proportional to the concentration of the active centers which hold  $A$  molecules. In other words, a desorption process also follows the law of mass action.

Eq. (5) is the rate equation for the reaction but it cannot be used as it stands because it contains the terms  $c_I$  and  $c_A$ . These are variables that cannot be measured. These quantities must be expressed in terms of variables that can be measured—the partial pressures of  $A$ ,  $R$  or  $S$ .

Since step 1 is the rate controlling step it is not at equilibrium and the equation  $K_1 = c_A / p_{AC_I}$  can not be used to evaluate  $c_A$ . However, steps 2, 3 and 4 are at equilibrium and the equilibrium equations of these steps may be used. From Eq. (2),

$$c_A = c_{RCS} / K_2 K_3 K_4 \quad (6)$$

and from Eq. (3) and (4),  $c_S = p_S c_I / K_3$  and  $c_S = p_S c_I / K_4$ . Putting these values in Eq. (6) gives:

$$c_A = p_S p_{SC_I} / K_2 K_3 K_4 \quad (7)$$

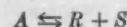
We can now substitute this value in Eq. (5) to give:

$$r = k_1 p_{AC_I} - (k'_1 p_S p_{SC_I} / K_2 K_3 K_4) \quad (8)$$

Since  $k_1 = k'_1 / K$ , we may factor  $k_1$  and  $c_I$ .

$$r = k_1 c_I [p_A - (p_S p_{SC_I} / K_1 K_2 K_3 K_4)] \quad (9)$$

And since steps 1 through 4 add up to the over-all reaction



the product  $K_1 K_2 K_3 K_4$  must be equal to the equilibrium constant,  $K$ , for the over-all reaction. Thus

$$r = k_1 c_I [p_A - (p_S p_{SC_I} / K)] \quad (10)$$

**Mechanisms and Their Corresponding Rate Equations**

| Chemical Equation                | Catalytic Steps  | Controlling Step  | Rate Equation  |
|----------------------------------|--|---|--|
| $A \rightleftharpoons R$         | $A + l \rightleftharpoons Al$<br>$Al \rightleftharpoons Rl$<br>$Rl \rightleftharpoons R + l$   | $A + l \rightleftharpoons Al$<br>$Al \rightleftharpoons Rl$<br>$Rl \rightleftharpoons R + l$  | $r = k[p_A - (p_R/K)]/(1 + K_R p_R)$<br>$r = k[p_A - (p_R/K)]/1 + K_A p_A + K_R p_R$<br>$r = k[p_A - (p_R/K)]/(1 + K_A p_A)$   |
| $A \rightleftharpoons R$         | $2A + l \rightleftharpoons A_2l$<br>$A_2l + l \rightleftharpoons 2Al$<br>$Al \rightleftharpoons Rl$<br>$Rl \rightleftharpoons R + l$                                     | $2A + l \rightleftharpoons A_2l$<br>$A_2l + l \rightleftharpoons 2Al$<br>$Al \rightleftharpoons Rl$<br>$Rl \rightleftharpoons R + l$    | $r = k[p_A^2 - (p_R^2/K^2)]/(1 + K_R p_R + K_R' p_R^2)$<br>$r = k[p_A^2 - (p_R^2/K^2)]/(1 + K_R p_R + K_A p_A^2)$<br>$r = k[p_A - (p_R/K)]/(1 + K_A p_A^2 + K_A' p_A + K_R p_R)$<br>$r = k[p_A - (p_R/K)]/(1 + K_A p_A^2 - K_A' p_A)$  |
| $A \rightleftharpoons R + S$     | $A + l \rightleftharpoons Al$<br>$Al + l \rightleftharpoons Rl + Sl$<br>$Rl \rightleftharpoons R + l$<br>$Sl \rightleftharpoons S + l$                                   | $A + l \rightleftharpoons Al$<br>$Al + l \rightleftharpoons Rl + Sl$<br>$Rl \rightleftharpoons R + l$                                   | $r = k[p_A - (p_{RPS}/K)]/(1 + K_{RSP} p_{RPS} + K_R p_R + K_{SPS})$<br>$r = k[p_A - (p_{RPS}/K)]/(1 + K_A p_A + K_R p_R + K_{SPS})$<br>$r = k[p_A - (p_{RPS}/K)]/p_S [1 + K_A p_A + (K_{ASPA}/p_S) + K_{SPS}]$  |
| $A \rightleftharpoons R + S$     | $A + l \rightleftharpoons Al$<br>$Al \rightleftharpoons Rl + S$<br>$Rl \rightleftharpoons R + l$   | $A + l \rightleftharpoons Al$<br>$Al \rightleftharpoons Rl + S$<br>$Rl \rightleftharpoons R + l$  | $r = k[p_A - (p_{RPS}/K)]/(1 + K_R p_R)$<br>$r = k[p_A - (p_{RPS}/K)]/(1 + K_A p_A + K_R p_R)$<br>$r = k[p_A - (p_{RPS}/K)]/p_S [1 + K_A p_A + (K_{ASPA}/p_S)]$  |
| $A + B \rightleftharpoons R + S$ | $A + l \rightleftharpoons Al$<br>$B + l \rightleftharpoons Bl$<br>$Al + Bl \rightleftharpoons Rl + Sl$<br>$Rl \rightleftharpoons R + l$<br>$Sl \rightleftharpoons S + l$ | $A + l \rightleftharpoons Al$<br>$B + l \rightleftharpoons Bl$<br>$Al + Bl \rightleftharpoons Rl + Sl$<br>$Rl \rightleftharpoons R + l$ | $r = k[p_A - (p_{RPS}/K_B)]/[1 + K_{RSP} p_{RPS} + K_B p_B + K_R p_R + K_{SPS}]$<br>$r = k[p_B - (p_{RPS}/K_A)]/[1 + K_{RSP} p_{RPS} + K_A p_A + K_R p_R + K_{SPS}]$<br>$r = k[p_A p_B - (p_{RPS}/K)]/(1 + K_A p_A + K_B p_B + K_R p_R + K_{SPS})$<br>$r = k[(p_A p_B/p_S) - (p_R/K)]/[1 + K_A p_A + K_B p_B + K_{SPS} + (K_{RSP} p_B/p_S)]$ |

This leaves  $c_i$  as the only variable that can not be measured experimentally. Since the total number of active centers,  $L$  (occupied or unoccupied), is independent of conversion, we can write

$$L = c_i + c_A + c_R + c_S \quad (11)$$

Substitution of the previously obtained values of  $c_A$ ,  $c_R$ , and  $c_S$  gives:

$$L = c_i + \frac{p_{RPS} c_i}{K_2 K_3 K_4} + \frac{p_R c_i}{K_3} + \frac{p_S c_i}{K_4} \quad (12)$$

Solving for  $c_i$ ,

$$L = c_i [1 + (p_{RPS}/K_2 K_3 K_4) + (p_R/K_3) + (p_S/K_4)] \quad (13)$$

$$c_i = L/[1 + (p_{RPS}/K_2 K_3 K_4) + (p_R/K_3) + (p_S/K_4)] \quad (13)$$

With the substitution of this value of  $c_i$ , Eq. (10) becomes:

$$r = \frac{k_1 L [p_A - (p_{RPS}/K)]}{[1 + (p_{RPS}/K_2 K_3 K_4) + (p_R/K_3) + (p_S/K_4)]} \quad (14)$$

or,

$$r = k [p_A - (p_{RPS}/K)]/(1 + K_{RSP} p_{RPS} + K_R p_R + K_{SPS}) \quad (15)$$

where  $k = k_1 L$ ;  $K_{RS} = 1/K_2 K_3 K_4 = K_1/K$ ;  $K_R = 1/K_3$  and  $K_S = 1/K_4$ .

Note that the denominator contains no  $p_A$  term and that it is taken to the first power. The denominator of a catalytic rate equation is the feature which distinguishes it from the rate equation of a homogeneous gas phase reaction.

For a simple order homogeneous gas phase reaction the rate equation would be:

$$r = k[p_A - (p_{RPS}/K)]$$

The denominator of Eq. (15) containing the adsorption terms would not appear (or might be considered as taken to the zero power). In Eq. (15) the denominator containing the adsorption terms is taken to the first power; also there is one "I" term in step 1, the controlling step of the reaction. We shall see later that the exponent of the denominator is equal to the number of active centers.

### What if Surface Reaction Controls?

The surface reaction is:



We can derive the over-all rate equation for the surface reaction controlling:

$$r = k_2 c_A c_i - k_2' c_B c_S \quad (16)$$

Since steps 1, 3 and 4 are at equilibrium, the following equations must hold:  $K_1 = c_A/p_A c_i$ ;  $K_S = p_S c_i/c_S$  and  $K_4 = p_S c_i/c_S$ .

Therefore,  $c_A = K_1 p_A c_i$ ,  $c_S = p_S c_i/K_S$  and  $c_S = p_S c_i/K_4$ . Making these substitutions in Eq. (16),

$$r = k_2 K_1 p_A c_i^2 - (k_2' p_A c_i p_S c_i / K_1 K_4)$$

Since  $k_2' = k_2/K_2$ , we may factor out  $k_2$  and  $c_i^2$  and divide

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through by  $K_4$  to clear the first term within the brackets of any coefficients. Thus,

$$r = k_3 K_1 c_i^2 [p_A - (p_R p_S / K_1 K_2 K_3 K_4)]$$

or,

$$r = k_3 K_1 c_i^2 [p_A - (p_R p_S / K)] \quad (16a)$$

Here we should note the similarity between Eqs. (10) and (16a). Eq. (10) contains  $c_i$  to the first power and is the equation for step 1 which involved one active center. Eq. (16a) is the equation for step 2 which involves two active centers. It has the term  $c_i^2$ .

The term  $c_i^2$  can be eliminated in the same way that we eliminated the  $c_i$  term above.

$$c_i^2 = L^2 / [1 + K_1 p_A + (p_R / K_1) + (p_S / K_4)]^2$$

$$r = k_3 K_1 L^2 [p_A - (p_R p_S / K)] / [1 + K_1 p_A + (p_R / K_1) + (p_S / K_4)]^2$$

$$r = k [p_A - (p_R p_S / K)] / (1 + K_1 p_A + K_R p_R + K_S p_S)^2 \quad (17)$$

where  $k = k_3 K_1 L^2$ ;  $K_1 = K_i$ ;  $1/K_1 = K_E$ ; and  $1/K_4 = K_S$ .

The equation for the controlling step contains two active centers and the denominator of Eq. (17) is raised to the second power. We can generalize now that the term containing the equilibrium adsorption constants is taken to the same power as the number of active centers involved in the controlling step. In noncatalytic reactions there are no active centers involved and so the denominator is taken to the zero power.

Comparison of Eqs. (15) and (17) shows another significant difference. A  $p_A$  term occurs in the denominator of Eq. (17) but does not appear in Eq. (15). Wherever the controlling step involves the adsorption of a reactant, the term involving the partial pressure of that reactant is absent from the adsorption terms in the rate equations.

### What About Desorption Controlling?

Now consider the case where the desorption of one of the products is the controlling step. Suppose that step 3,  $R \rightleftharpoons R_1$  going reversibly to  $R$  and  $I$ , were the controlling step. The rate equation would be:

### NEXT MONTH

We'll derive just a few more rate equations. We'll discuss the strong points and the shortcomings of this type of equation and try to evaluate the assumptions upon which they are based.

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$$r = k_S c_R - k'_S - p_R c_i \quad (18)$$

and from Eqs. 1, 2 and 4 which are at equilibrium,  $c_A = K_1 p_A c_i$ ,  $c_R = K_S c_A c_i c_S$ ; and  $c_S = p_S c_i / K_4$ .

Eliminate  $c_A$  and  $c_S$  from the first by substituting their values from the next two equations.

$$c_R = K_3 K_4 p_A c_i / p_S$$

This value of  $c_R$  is substituted in the rate equation (18),

$$r = (k_3 K_2 K_1 K_4 p_A c_i / p_S) - k'_S p_R c_i$$

Substitute  $k_1 / K_1$  for  $k'_S$  and factor out  $c_i$  and  $k_3 K_2 K_1 K_4$ .

$$r = k_3 K_2 K_1 K_4 c_i [(p_A / p_S) - (p_R / K_1 K_2 K_3 K_4)]$$

Now we must eliminate the variable  $c_i$  as we did before.

$$c_i = L / [1 - K_1 p_A + (K_1 K_2 K_3 K_4 p_A / p_S) + (p_S / K_4)]$$

Thus,

$$r = \frac{k_3 K_1 K_2 K_4 L [(p_A / p_S) - (p_R / K_4)]}{(1 - K_1 p_A - (K_1 K_2 K_3 K_4 p_A / p_S) - (p_S / K_4))}$$

or,

$$r = \frac{k [p_A - (p_R p_S / K)]}{p_S [1 + K_1 p_A + (K_1 K_2 K_3 K_4 p_A / p_S) + K_S p_S]} \quad (19)$$

In Eq. (19) the denominator is again taken to the first power since only one active center is involved in the controlling step. No  $p_R$  term appears in the denominator since it is the desorption of  $R$  that is the controlling step. However, there is one difference between this and previous equations. The adsorption terms are multiplied by the partial pressure of  $S$ , the product whose desorption is not controlling.

### Derivation of Additional Equations

We think it will be worthwhile to derive some additional common rate equations. And we plan to do that next month.

The equations derived represent only a small part of the total that may be possible. A more complete discussion of this type is presented in reference (1) below, and we refer you to that very excellent text on this subject. The same type of equation is also presented in Laidler's text.<sup>2</sup>

In the meantime, for your convenience, we are including in this installment a table of reaction mechanisms and their corresponding rate equations. Several of the most common reaction types are included. To say that the mechanisms shown are the most probable would be mere conjecture. Just because the simple mechanisms postulated seem probable does not necessarily mean that they are the mechanisms of most catalytic reactions. Few catalytic reactions have been studied from this point of view to date.

It is difficult to state, therefore, whether the mechanisms that are simplest to suppose are those which happen to occur in most cases.

### REFERENCES

- Hougen, O. A. and K. M. Watson, "Chemical Process Principles—Part III," John Wiley & Sons, Inc., New York (1947).
- Laidler, K. J., "Chemical Kinetics," McGraw-Hill Book Co., Inc., New York (1950).

for HOT  
corrosives

# ace tempron

*New* HIGH HEAT RESISTANT  
HARD RUBBER

pipe · fittings · chemical parts

**Ace Tempron** . . . a new synthetic hard rubber for chemical equipment—now offers unexcelled chemical resistance *plus* economy for high temperature applications. In your plant, Tempron can handle many corrosive liquids—*hot*—at costs below other materials you've had to use up to now.

Based on nitrile synthetic rubber (Buna-N), Tempron is *hard* rubber—with better temperature and chemical resistance than hard or soft nitrile rubber compounds hitherto available. Mechanically it withstands temperatures up to 225 deg. F. and higher. Chemically it resists most inorganic chemicals and many organic chemicals and oils at temperatures to 200 deg. F.—and far higher in specific instances. At room temperature it has better resistance to some of the organic chemicals than other rubber and plastic materials.

In one case, Tempron pipe is still in excellent condition after 2 years on hot brine, far exceeding the life of the steel pipe it replaced.

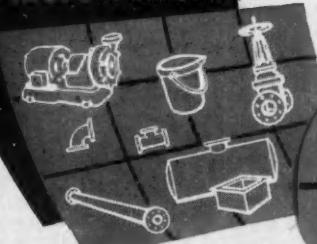
We're now ready with Tempron pipe in 1", 1½", 2", 3" and 4" sizes and fittings in 2", 3" and 4" sizes. Additional smaller sizes of pipe and fittings are under development. We can also—now—produce molded parts, and sheets, rods and tubes from which we (or you) can fabricate a wide variety of parts.

Write today for new bulletin No. 96-A giving full details of Tempron. Or ask for samples and recommendations for your specific applications.

#### ACE TEMPRON resists:

|                          |   |   |  |
|--------------------------|---|---|--|
| TESTED AT<br>200 deg. F. | Hydrochloric Acid, 38%<br>Sulphuric Acid, 50%<br>Phosphoric Acid, 85% | Sodium Hydroxide, 20%<br>Sodium Chloride<br>Ethylene Glycol | Formaldehyde<br>Kerosene<br>Ferric Chloride<br>Stannous Chloride         |
| TESTED AT<br>78 deg. F.  | Benzaldehyde<br>Aniline<br>Pyridine<br>Gasoline                       | Ethyl Acetate<br>Benzene<br>Toluene<br>Carbon Tetrachloride | Ethylene Dichloride<br>Chlorobenzene<br>Carbon Disulfide<br>Nitrobenzene |

more RESISTANT  
TO more CHEMICALS



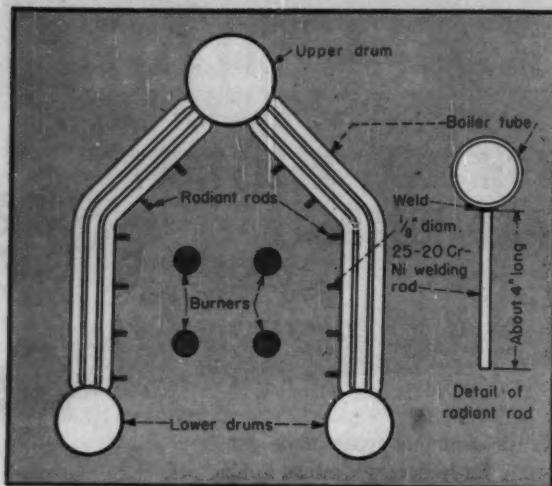
#### ACE rubber and plastic products

AMERICAN HARD RUBBER COMPANY  
93 WORTH STREET • NEW YORK 13, N. Y.

# The Plant Notebook

Edited by Theodore R. Olive

## Winner of \$100 Annual Plant Notebook Award\*



### "Hot Rods" on Tubes Show Boiler Temperature Variations

Harlan How

Equipment Design Consultant, New Bern, N. C.

During the war there was considerable trouble with four large Dowtherm boilers in the D.P.C. butadiene plant at Kobuta, Pa. We found that the decomposition of the fluid was high and we knew that the operation of the gas burners in the walls of the furnaces was erratic. Overheating of the radiant tube surfaces facing the fire was becoming a serious matter. There had been several cases of badly leaking tubes and it was largely good fortune that we did not have a fire.

When the trouble was discovered and the heaters shut down, it required a lot of thought to find a simple, practical method which would show overheated zones and permit the burners to be adjusted accurately. Conventional methods of temperature indication were

obviously not suited in this case since they would be too difficult to apply and probably would not assure positive results.

The solution I worked out was simplicity itself. It enabled the operators immediately to detect any hot spots in the furnace by visual inspection and, hence, to adjust one or more of the multiple burners to obtain a satisfactory temperature distribution. There were no more leaky tubes due to improper burner operation and the entire performance of the heaters was much improved.

This scheme consisted simply in welding 4-in. lengths of  $\frac{1}{8}$ -in. 25-20 Cr-Ni welding rod at right angles to the boiler tubes on the radiant side, so that they projected into the furnace space. These were spaced about 3 ft. apart both vertically and horizontally so that the entire inner radiant surface of the boiler was studded with the rods on 3-ft. centers. They were electrically welded to the tubes by a short flash in a manner similar to a stud welder, simply by holding the rod in an ordinary electrode holder.

When the boiler was in use the transfer of heat through the length of the radiant rods would be slow enough, of course, so that their free ends would glow. Variations in the rate of heat release at different points were immediately and vividly visible simply by noting the differences in color temperature of the rods. The method is so sensitive that even the normal fluctuations of gas burners become visible in this way.

There is no reason why this method should not be equally useful in other sorts of radiantly heated tubular equipment, for example, pipe heaters and stills for oil and organic chemicals which are subject to local overheating and decomposition. There is probably less reason to use it in steam boilers than in organic-materials heaters, but even in this case there are doubtless balky boilers that would be helped by it.

\*Here, reprinted from the August issue, is the article chosen as the best monthly Plant Notebook winner of 1954. The author has received his original prize and will now receive an added prize of \$100. Turn the page to see this month's regular winner.

### ★ November Contest Prize Winner.

"Heat-Transfer Putty Improves Steam Tracing Of Valves and Pipe."

A prize of \$50 in cash will be awarded to W. Wesley Weidman, Engineering Research Laboratory, Engineering Dept., E. I. du Pont de Nemours & Co., Wilmington, Del. The article will appear in February.

\$50 PRIZE FOR A GOOD IDEA—Until further notice the Editors of Chemical Engineering will award \$50

cash each month to the author of the best short article received that month and accepted for publication in the Plant Notebook. Each month's winner will be announced the second following month and published the third following month.

\$100 ANNUAL PRIZE—At the end of each year the monthly winners will be rejudged to determine the year's best Plant Notebook article, which will then be awarded an additional \$100 prize.

HOW TO ENTER CONTEST—Any reader of Chemical Engineering, other

than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable but non-winning articles will be published at regular space rates (\$10 minimum).

Articles may deal with plant or production "kinks," or novel means of presenting useful data, which will interest chemical engineers. Address Plant Notebook Editor, Chemical Engineering, 330 West 42nd St., New York 36, N. Y.

# Which is your drying problem?

- SLOW START-UPS       UNEVEN DRYING
- ERRATIC TEMPERATURES       PRODUCT SPOILAGE
- LOW OUTPUT       HIGH STEAM CONSUMPTION
- VARIABLE DRYING RATES

*Often the solution  
is simple and inexpensive...*

While it's human to blame these dryer problems on the dryers themselves, the truth is that they're often due to...

...use of the wrong type of steam trap, causing equipment to waterlog ... or heat-robbing air in steam spaces ... or wasteful, unreliable, manual temperature control.

Any one of these could cause poor dryer performance ... loss of production, product spoilage, waste of manpower and steam.

See (right) how simply and inexpensively these troubles have been cured by Sarco products and know-how. Tell us about your problems and we'll be happy to put our 43 years of experience to work for you. Just call your nearest Sarco representative, or write Sarco Company, Inc., Empire State Bldg., New York 1, N. Y.

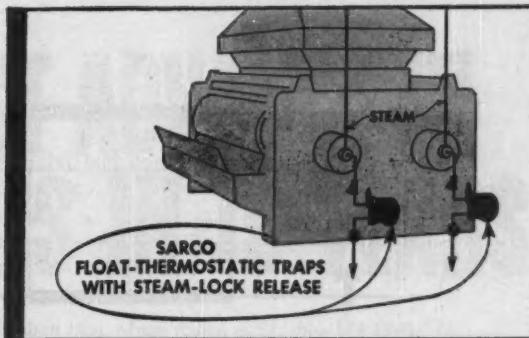
# SARCO

*improves product quality and output*

Sarco has a wealth of helpful information on trapping, air venting and temperature control. Tell us about your problem — we'll be glad to send you this information and case history solutions to problems similar to yours.

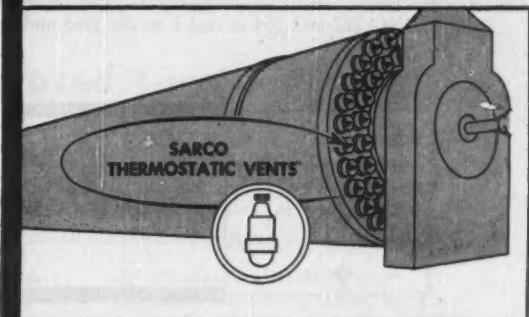


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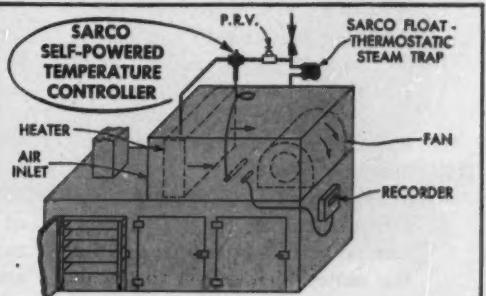
**SPOTTY DRYING ELIMINATED:** This atmospheric double drum dryer periodically waterlogged because of steam-lock in syphon pipe. Cold spots on drum surfaces, uneven drying and production slow-downs resulted.

By simply replacing the original traps with Sarco Float-Thermostatic Traps equipped with built-in steam-lock release valves ... these drying troubles were completely eliminated.



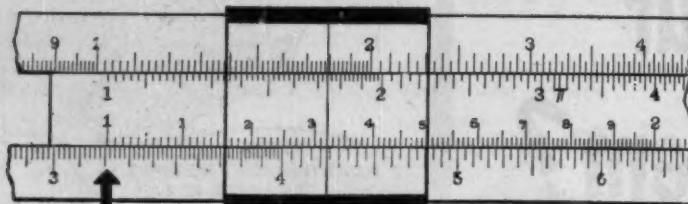
**CURE FOR SLOW WARM-UP:** When air gets into steam spaces of a dryer it forms a heat-insulating film between the steam and heat-transfer surfaces ... efficient transfer of heat from steam is impossible. Result: slow warm-up; prolonged drying time.

Simple, inexpensive cure for this condition are Sarco Air Vents, such as installed on above rotary steam tube dryer.

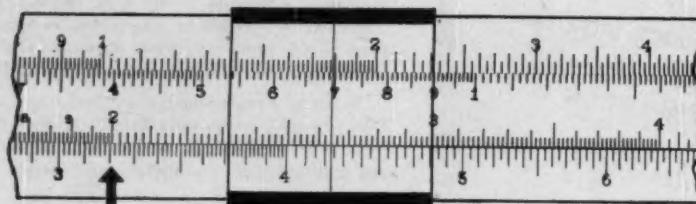


**TEMPERATURE PROBLEMS SOLVED:** Manipulating steam valves to control temperature wastes manpower and steam...is often the cause of product spoilage.

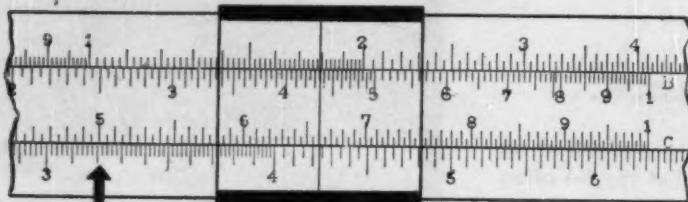
Sarco Self-Powered Temperature Controllers, as on this tray dryer, solve this problem ... hold dryer at maximum temperature without danger of overheating. Inexpensive, simple and dependable.



USING 131 and 132 as match marks, read under 1—(Fig. 1)



USING 262 and 264 as match marks, read under 2—(Fig. 2)



USING 655 and 660 as match marks, read under 5—(Fig. 3)

#### ★ October Contest Prize Winner

### Read Your Slide Rule to Four Places

**Royes Salmon**

Process Engineering Group, Union Oil Co. of California, Brea, Calif.

In case you ever have an urge to read your slide rule to four figures, here is one way it can be done. The method makes use of a modified vernier principle in which you find a pair of adjacent divisions on one scale ("match marks") which exactly match the distance between the desired answer on another scale, as marked by the hairline, and the nearest division on that scale. Of course, "slide-rule accuracy" seldom demands that extra decimal place, but it is an interesting trick which slide-rule addicts will want to know, "just in case."

Note that the subdivisions on the C and D scales from 1 to 2, from 2 to 4, and from 5 to 10 are of identical pattern and width. Only be-

tween 4 and 5 is there an odd pattern. So, match marks can usually be found between 1 and 2 or, failing that, between 4 and 5.

Let's say that the hairline is around 423 on the D scale and we want one more figure. Move the C scale until the space between two of its scale subdivisions coincides exactly with the space between 420 and the hairline. In this case you will find that there are three such positions or match marks, but first we shall examine only one of them, the points 131 and 132 on the C scale, in which 131 coincides with 420 and 132 coincides with the hairline.

Since 132 minus 131 is 1, read the D scale below 1 on the C scale

to get the amount that must be added to 420. (See Fig. 1.) In this case this gives approximately 3.2, so that the true hairline reading is  $420 + 3.2 = 423.2$ . But we might have used 262 and 264 on the C scale (Fig. 2), or 655 and 660 (Fig. 3). Since the difference between the first of these pairs is 2, we read below 2 on the C scale, again getting 3.2 as the quantity that must be added. If we used 655 and 660, the difference would be 5, so we would read below 5 on the C scale and again come up with 3.2 as the quantity to be added.

This method actually involves finding a pair of numbers, the difference in whose logs is equal to the difference in logs between the number under the hairline, and the number represented by the nearest lower scale division shown on the D scale.

Sometimes it works out that a subtractive use of the method will be more convenient. To do this we first match the distance from the hairline to the next higher scale division, then subtract the number we find from the value of the scale division appearing to the right of the hairline.

The method can be proved easily. Call the hairline reading X. Then:

$$\frac{X}{132} \times 131 = 420$$

This, you will note, is the actual setting of the slide rule.

$$X = \frac{132}{131} \times 420 = 420 + \frac{420}{131}$$

Now, the setting of the slide rule shows that  $420/131 = 3.2$ , so  $X = 420 + 3.2 = 423.2$ .

The same type of proof applies in case the subdivision width is either 2 or 5. For example:

$$\frac{X}{264} \times 262 = 420 \text{ (slide rule setting)}$$

$$X = \frac{264}{262} \times 420 = 420 + 2 \times \frac{420}{262}$$

Again, the slide rule setting shows that  $2 \times (420/262) = 3.2$ , so  $X = 420 + 3.2 = 423.2$ .

With a little practice the method can also be used in reverse to obtain an accurate setting. Suppose we want to set the hairline to 466.1

# DURADOME

## TANK CAR PRODUCTION HIGHLIGHTS



### PLANING ...

Heavy gauge steel plate is cut to precision width with edges squared and beveled for fitting and welding—all in one automatic planing operation.



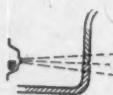
### ROLLING ...

Steel plate is then precision roll-formed by heavy duty rolls capable of handling large steel plates up to two inches thick.



### FLUING ...

A specially-built giant press forms the dome base by actually pressing and fluing it out of the heavy center section.



### X-RAYING ...

Automatic butt welds are used throughout. This results in stronger joints, and permits direct x-raying, guaranteeing sound welds.

# GREATEST ADVANCE IN TANK CARS IN 15 YEARS

acf built

# DURADOME

*flued dome tank car*

### Improved 4 ways

**1 Flued Dome** . . . dome base actually pressed out of heavy steel plate — eliminating fillet welds and dome shelf for more strength and corrosion resistance.

**2 Pressure-type Construction** . . . uses complete "ring-sections" or cylinders to build up the tank. That means heavier steel all the way around for greater durability.

**3 All-welded Insulation Jacket** (when required) . . . angles and bolts completely eliminated. Streamlined—more weatherproof—needs less maintenance.

**4 Standardized Underframe** . . . the same, all-welded underframe for tanks of all standard types and capacities. Provides flexibility; economical maintenance!



The DURADOME car is available for lease or sale through . . .



## SHIPPERS' CAR LINE CORPORATION

30 Church Street, New York 7, N. Y.

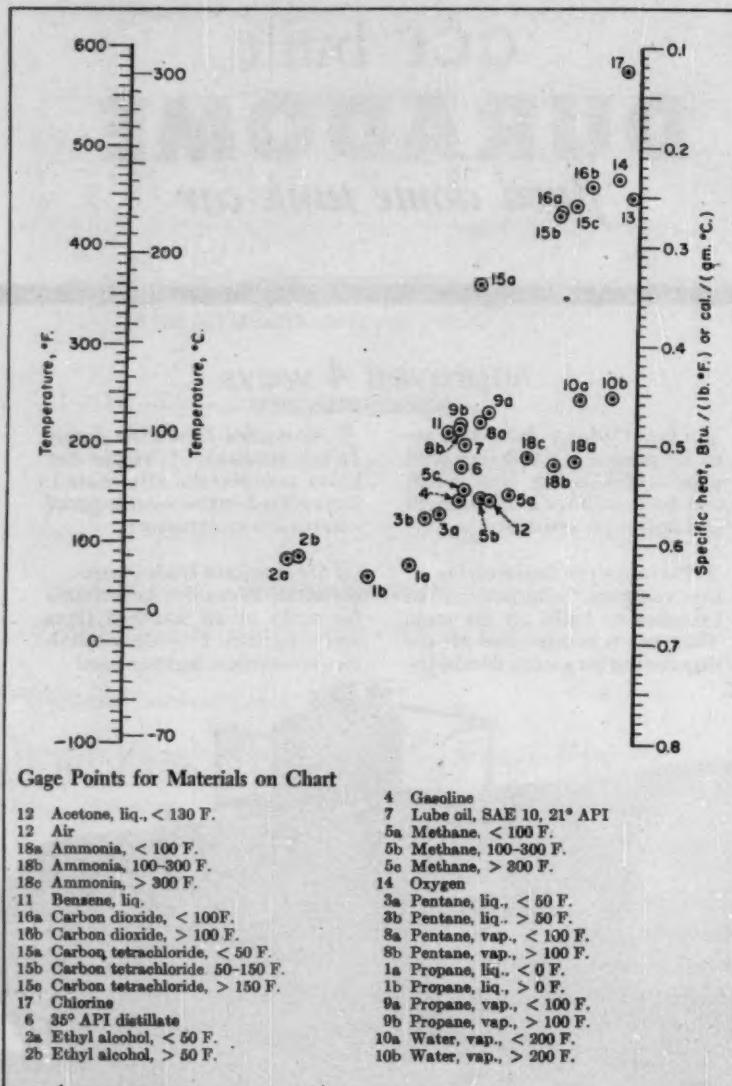
A subsidiary of ACF INDUSTRIES Incorporated

CHICAGO, ILL. • HOUSTON, TEX. • SAN FRANCISCO, CAL. • MILTON, PA. • EAST ST. LOUIS, ILL. • SMACKOVER, ARK. • TULSA, OKLA. • NORTH KANSAS CITY, MO.

## PLANT NOTEBOOK . . .

on the D scale. Subtracting from 470.0, we get 3.9. Setting 2 on the C scale over 3.9, we find that with a little adjustment 242 on C falls over 470 on D, while 240 on

C marks the spot where the hairline should be. In the process of adjustment the 2 on C was moved over 3.88 (rather than 3.9), but the resulting error is negligible.



## Chart Gives Specific Heats of Fluids

D. S. Davis

Professor of Chemical Engineering, Virginia Polytech. Inst., Blacksburg, Va.

Designers of heat transfer equipment frequently need reliable values of the specific heats of liquids and gases, often over wide ranges of temperature. The accompanying line coordinate chart enables con-

venient estimates to be made of the specific heats of 18 common liquids and gases at a pressure of 1 atm.

The use of the chart, which is based on data given by Brown et

al ("Unit Operations," p. 587, Wiley, New York, 1950), is illustrated as follows: What is the specific heat of propane vapor at 200 F.? For temperatures above 100 F., the gage point for propane vapor is 9b in the accompanying table. Connect 200 on the temperature scale with Point 9b and read the desired specific heat as 0.470 Btu./(lb.°F.).

## Propeller Positioning Improves Mixing

A. P. Weber

Technical Director, International Engineering Co., New York.

How a mixer of the propeller type is positioned in a tank can have a pronounced effect on the time and cost of mixing. The wrong position wastes power and can also have other bad effects.

We can look on a propeller mixer as a caseless axial-flow pump with which we wish to turn over the entire tank contents as rapidly as possible, while at the same time creating "antagonistic" horizontal and vertical flowlines. We must minimize swirl which wastes power in horizontal circling without vertical turnover. We must keep down velocity losses in deflecting the flowlines in the vessel, and see to it that there are unbalanced forces so that a vortex and its accompanying swirl will be avoided.

We can create a curved path across the vessel bottom by offsetting the propeller from the vessel centerline. This offset combines with the helical rotation of the stream to deflect the stream toward the top at the opposite tank wall, with minimum loss in velocity. It gives a top-to-bottom turnover which complements the primary horizontal or rotary motion. Thus antagonistic horizontal and vertical flow components are produced to achieve the desired condition of disorganization.

Baffles properly placed will provide flow patterns similar to those from offset mixers, but baffles are more costly, they waste energy, and they offer cleaning problems. So, offsetting is preferred to baffles.

(Continued on p. 210)

# SIMPLIFY

## HANDLING OF CORROSIVE CHEMICALS

### PENBERTHY USCOLITE\* EJECTORS



#### HYDRAULIC OPERATED FOR...

Liquid Transfer  
Mixing and Blending  
Pumping fluids with solids in suspensions or in slurries  
Pumping Gases  
Gas or Vapor Removal  
Aerating Liquids

#### PROPERTIES

Rigid • Tough • Lightweight • Non-toxic  
Non-contaminating • Excellent chemical resistance  
Inertness • Low thermal conductivity • Operation temperatures up to 170° F • High safety factor • Withstands abuse and severe service • Physicals superior to most plastics.

#### TYPICAL APPLICATIONS

Chemical processing • Pharmaceuticals  
Water Softening (Zeolite & others) • Plating • Textile dyeing and finishing • Mixing and blending beverages • Tanning • Bleach manufacture • Paper industry • Electro chemicals...and other processes involving the handling of corrosive liquids or gases.

### PENBERTHY STAINLESS STEEL "RATED JET" EJECTORS



#### STEAM, AIR, LIQUID OPERATED FOR...

Liquid Transfer  
Heating  
Circulating  
Aerating  
Agitating  
Mixing  
Pumping gases  
Exhausting air or vapor against high vacuum

#### PROPERTIES

Corrosion resistance of any type of stainless is combined in a simple design of sound principle to provide extended service under corrosive conditions.

#### TYPICAL APPLICATIONS

Handling corrosive liquid or gas where color, taste or odor are important: Chemical  
Dairy • Food • Textile • Beverage  
Sterilizer...and similar applications.

Where corrosion resistance is essential:  
Chemical • Sewage • Petroleum • Textile • Water treatment...and similar applications.

At temperatures where plastics, metals and other materials are not suitable.

#### Many advantages over mechanical pumps

Consider the economy of low initial cost with practically no maintenance...no moving parts, no lubrication, no packing glands. Expect and get noiseless, trouble-free operation for long operating periods under corrosive conditions.

Penberthy offers many sizes and types of ejectors for immediate shipment from stock or "tailored" to your particular application.

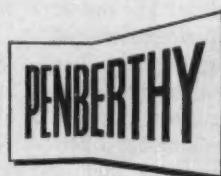
#### WRITE FOR CATALOG 512

detailing the complete line or ask our engineers for specific information. You will find Penberthy Injectors worth investigating.

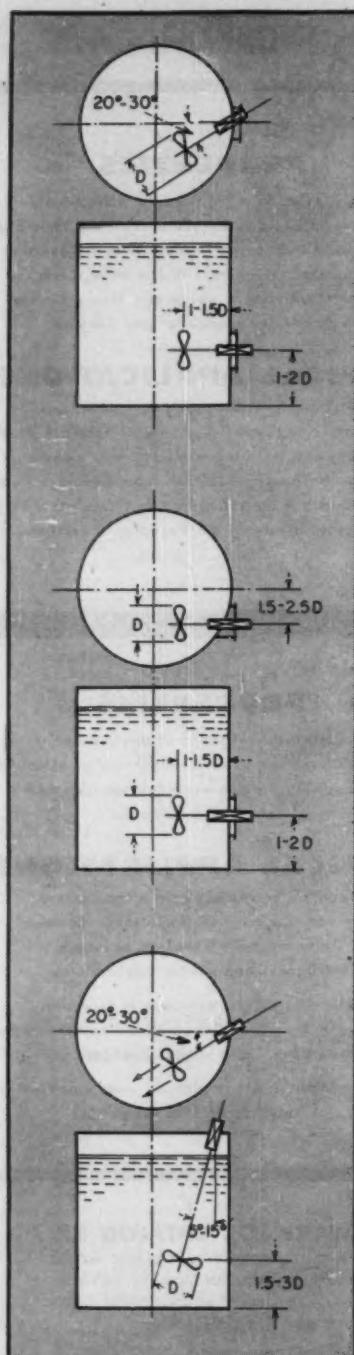
#### PENBERTHY INJECTOR COMPANY

Division of the Buffalo-Eclipse Corporation  
1242 Holden Avenue • Detroit 2, Michigan  
Established 1866

There's Certain satisfaction in **PRODUCTS BY**



- CYCLING JET PUMPS
- EJECTORS
- INJECTORS
- ELECTRIC SUMP PUMPS
- EDUCTORS
- EXHAUSTERS
- SYPHONS



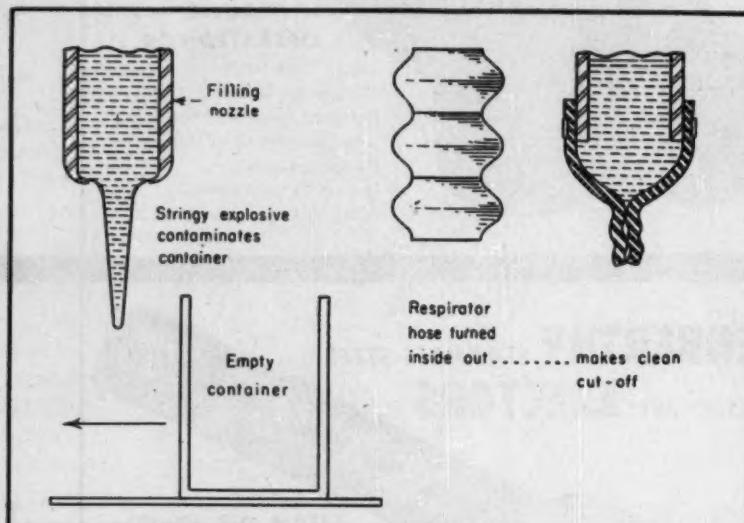
The sketches above show how these objectives are secured. Those at the top show two ways to use side-entering propellers. The one at the bottom is the preferred way of using a top-entering propeller. For best results the vessel height should be equal to or greater than its diameter. In all the sketches a left-hand propeller is assumed, that is,

rotation is counter-clockwise when facing the propeller.

Sometimes centerline positioning is desirable if a vortex is needed to suck down a light powder that tends to float, or to draw in air to aerate the mix. But the overall mixing action will be inefficient. And a vortex is particularly undesirable if foaming results when air is sucked into the batch.

With the same rotation of the propeller, use of the mirror-image positions, that is, in the adjacent quadrants in the sketches, will not produce a vortex, but it will produce excessive swirl with negligible vertical turnover.

Although this arrangement makes for less efficient mixing, it may sometimes be desired when washing fragile fibers.



## Getting Sharp Cut-Off on Stringy Liquid

**Floyd L. Hill**

Assistant Project Engineer, Thiokol Chemical Corp., Marshall, Tex.

An exasperating problem arose in the metering of a viscous explosive compound, with a consistency like peanut butter, into containers carried under the filling head on a continuous conveyor. Dripping and "stringing" from the filling nozzle contaminated the exterior surfaces of the containers. The usual approach of bellining in the nozzle was unsuccessful. Also, spring-loaded cut-offs were not acceptable, since metal-to-metal contact would have presented danger points in an explosive operation.

At length we solved the problem through the use of ordinary corrugated rubber respirator hose. We found that when such hose is turned inside out, it tends to close almost completely. Therefore, a

short section of hose was turned inside out and forced over the end of the filling nozzle, where it was clamped in place.

This simple device nipped off the stringy product effectively after each pressure stroke. It proved to be economical and, even more important, safe.

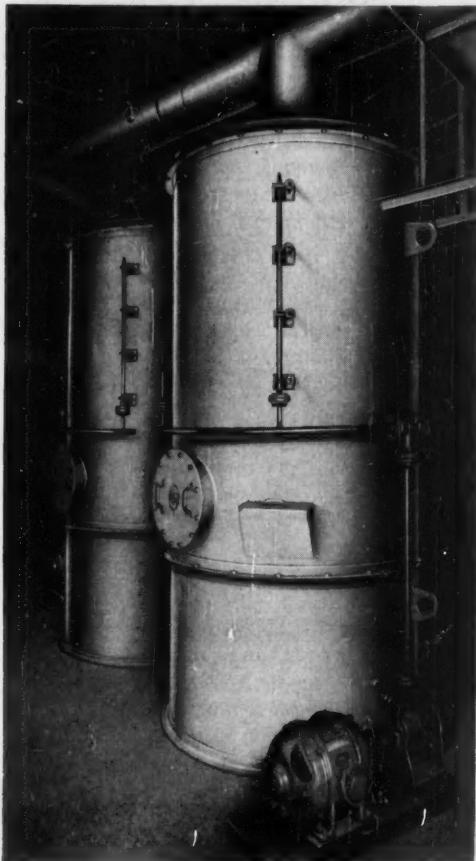
## Adhesive "Sticks" Most Pilot Plant Materials

**Ved Swarup Gupta**

Chemical Engineer, Gupta Iron & Brass Works, Shahdara, Delhi, India.

For an adhesive which will make leak-proof repairs and joints in almost all materials used around the

# DUST and FUME Control



## MAHON FOG-FILTERS AT WORK

The installation illustrated above was specially designed for the Motor State Oil & Grease Co., Jackson, Mich. PROBLEM: To eliminate H<sub>2</sub>S odor from sulphonated grease manufacturing operations. The problem was complicated by grease and oil fumes present in H<sub>2</sub>S gas. SOLUTION: A two-tower Fog-Filter connected in series was designed with high pressure water fog collecting practically all of the grease and oil fumes in the first tower. A caustic solution employed in the second tower and fogged at lower pressure removes the remaining H<sub>2</sub>S from the air before it is exhausted into the atmosphere.

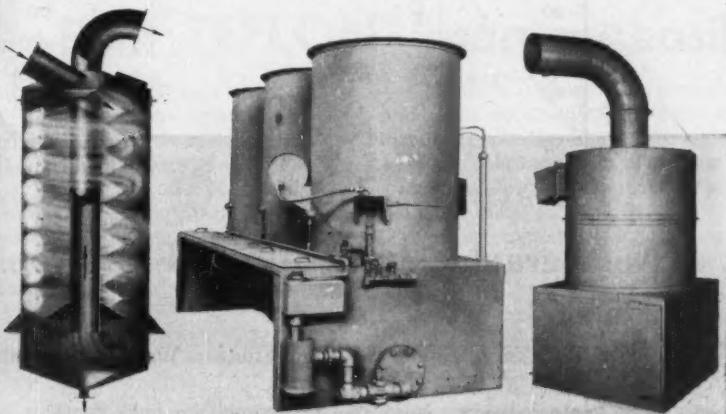
Special equipment engineered to solve individual problems posed by dusts of all kinds, fly ash, chemical fumes, gases of any temperature, aerosols, and other troublesome air pollutants

In dealing with air contaminants, each individual air cleaning problem must be approached with a view to determining what type of collector or filter is required to produce maximum results under existing conditions. Study and analysis of the character and extent of the pollutant is therefore imperative in arriving at a satisfactory solution. Mahon dust and fume control engineers have, over a period of years, developed and perfected special Wet and Dry Collectors and Fog-Filters which have proved highly successful in coping with all types of industrial air contaminants—a few are illustrated here . . . they are serving today in some of the most difficult and mandatory air cleaning jobs in industry. Each installation has been engineered to do the specific job. If you have an air pollution problem, regardless of its character, it will pay you to call in a Mahon engineer and let him show you what Mahon equipment has done with like pollutants under conditions comparable to your own. See Mahon's Insert in Sweet's Mechanical Industries File for further information, or write for Industrial Equipment Catalog A-655.

**THE R. C. MAHON COMPANY**  
Main Plant and Home Office, Detroit 34, Michigan

Engineers and Manufacturers of Dust and Fume Control Equipment Including Cyclone Collectors, Hydro-Foam Collectors, Jet Trap Collectors, Hydro-Filter Collectors, and Fog-Filters and Cupola Stack Washers.

All Mahon Equipment is Erected by Mahon to Insure Complete Satisfaction.



Fog-Filter

Hydro-Foam Dust Collector

Jet Trap Dust Collector

# MAHON

## PLANT NOTEBOOK . . .

laboratory and pilot plant, the following simple mixture works well. Take equal volumes of wet slaked lime and powdered sugar. Mix and rub them together well to a sticky paste, and use the mixture immediately. Pressing the parts together

and warming them will give better results.

This adhesive will secure wood pieces, steel plates, cement-asbestos sheets and chemical stoneware, to name a few materials on which it is successful.

where  $H$  is pounds of water per 1 lb. of dry air;  $p$  is saturation pressure of water vapor; and  $P$  is total pressure. Here 18.02 and 28.97 are the molecular weights of water and air respectively.

This chart shows the 100% absolute humidity which varies with changes in absolute pressure, or altitude, or both. It also replaces the Dalton charts commonly used, which are much more cumbersome. Furthermore, lines A and B show the vapor pressure of water at different temperatures.

A couple of examples will best illustrate the use of the chart.

**Example 1**—How much water will be condensed if 1 lb. of dry air saturated at 100 F. and 760 mm. Hg abs. pressure is compressed to 5 psig. at constant temperature?

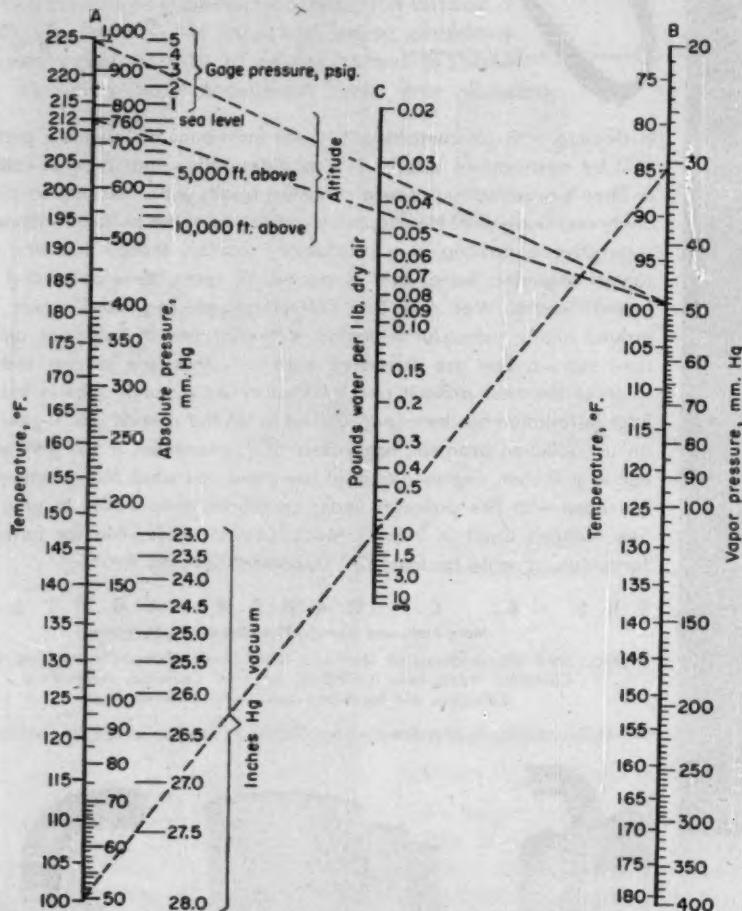
**Solution**—Connect the point reading 760 on Line A with 100 F. on Line B and read 0.043 lb. water per lb. of air on Line C.

Then connect the point reading 5 psig. on A with the 100 F. point on B and read 0.032 lb. water per lb. air on C. Therefore, on compression from zero to 5 psig. at sea level 0.043–0.032 or 0.011 lb. water per lb. air, will be condensed at constant temperature.

**Example 2**—Assume that the last effect of a multiple-effect evaporator system operates under 28 in. Hg vacuum. The cooling water of the main condenser may reach a maximum of 80 F. in summer. The ejector must be able to maintain this vacuum, assuming a minimum of 20 lb./hr. of dry air is allowed to leak into the system.

**Solution**—Assume that the air leaves the condenser saturated at 5 F. higher than the entering condenser water, that is, 85 F. Connect the point reading 28 in. Hg vacuum on Line A with 85 F. on Line B and read 0.95 lb. water per lb. air. Your ejector then must be able to handle  $(20)(1 + 0.95)$  or 39 lb./hr. of humid air.

Charts from vacuum equipment manufacturers will then enable you to size the equipment and make an economic study of the process. However, for firm prices and performance guarantees it will be necessary to consult your supplier.



## Nomograph Solves Saturated-Air Problems

M. Rhoden

Chemical Engineer, Crystallizer Dept., Struthers Wells Corp., Warren, Pa.

Absolute humidity is of major importance in the design of equipment for the chemical industry. Its application lies in such fields as drying, air-conditioning, vacuum equipment, and many others.

Saturation or 100% absolute humidity is defined as the maxi-

mum amount of water vapor a gas will carry under specific conditions of temperature and pressure.

For air and water vapor, humidity is expressed by the equation

$$H = \frac{p}{(P-p)} \frac{18.02}{(28.97)}$$



Better Things, for Better Living  
through Chemistry

# CHEMICAL ENGINEERING NEWS

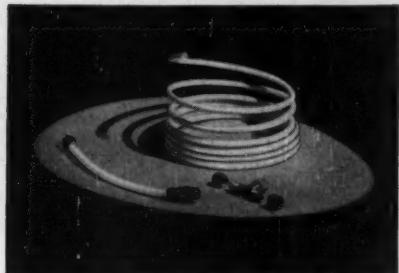
PROPERTY AND APPLICATION DATA ON THESE  
VERSATILE ENGINEERING MATERIALS: "ZYTEL,"  
"ALATHON," "TEFLON," "LUCITE."

- NO. 1 -

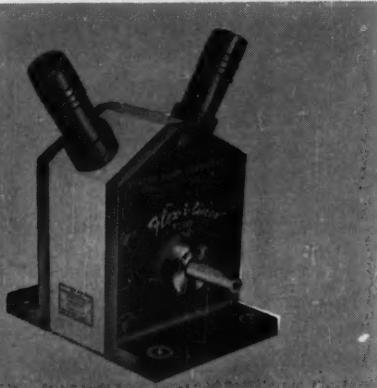
- 1955 -

## Thin-wall tubing of TEFLON® is chemically inert and non-contaminating

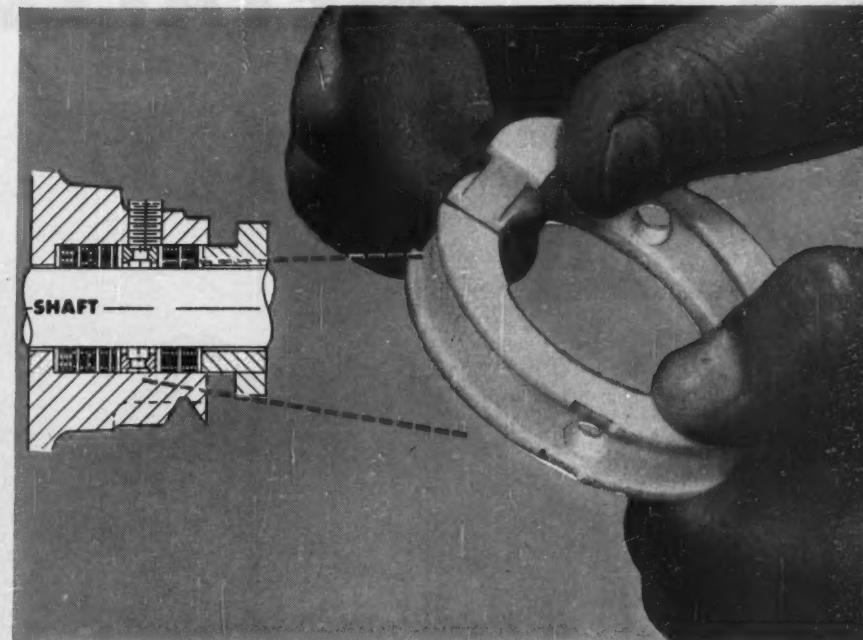
Assembly is easier with these extruded thin-wall tubings of Du Pont "Teflon" tetrafluoroethylene resin. They can be cut with a knife and bent by hand. Because "Teflon" has a smooth, waxlike surface, the tubing slips into position easily. The chemical inertness, resistance to heat and cold, strength and excellent dielectric properties give this tubing of "Teflon" a wide range of applications.



Flexible tubing of "Teflon" is lightweight, chemically inert, has a working temperature range of -450°F. to 500°F. (Manufactured by the Halogen Insulator and Seal Corp., Franklin Park, Illinois.)



**BODY BLOCK** in the "Flex-i-liner" pump, manufactured by Vanton Pump and Equipment Co. Inc., New York City, uses molded Du Pont "Alathon" polyethylene resin. It is designed to handle a wide range of corrosive fluids. "Alathon" is lightweight and stands up well against abrasive slurries. The molded construction means fewer parts. Tough, flexible Du Pont "Alathon" is also widely used in industrial pipe applications. Use the coupon at right for complete property data on this Du Pont engineering material.



Flexible seal cage molded of Du Pont "Teflon" tetrafluoroethylene resin. It is tough, chemically inert, resists high and low temperatures. (Manufactured by Chemical and Power Products, Inc., N.Y.)

## Tough, flexible seal cages of Du Pont TEFLON® snap on easily

These flexible seal cages of Du Pont "Teflon" tetrafluoroethylene resin supply annular space in packing for lubrication with oil or grease, or for cooling. They snap on and off a shaft easily—yet are tough and won't bend or collapse under extreme gland pressure. And there's no danger these seal cages of "Teflon" will score the shaft or sleeve.

"Teflon" is used extensively in process industries. Its chemical inertness, high heat resistance, low-temperature toughness and low coefficient of friction are properties especially adaptable for tough service conditions.

Use the coupon below for complete information on this versatile engineering material.

### NEED MORE INFORMATION?

CLIP THE COUPON for additional data on the properties and applications of these Du Pont engineering materials.

\*"Teflon", "Alathon" and "Lucite" are registered trademarks of E. I. du Pont de Nemours & Co. (Inc.) †"Zytel" is the new trade-mark for Du Pont nylon resin.

E. I. du Pont de Nemours & Co. (Inc.), Polymers Department Room 251, Du Pont Building, Wilmington 98, Delaware

Please send me more information on the Du Pont engineering materials checked:  "Teflon" tetrafluoroethylene resin;  "Alathon" polyethylene resin;  "Zytel"† nylon resin;  "Lucite"\*\* acrylic resin. I am interested in evaluating these materials for

NAME \_\_\_\_\_

POSITION \_\_\_\_\_

COMPANY \_\_\_\_\_

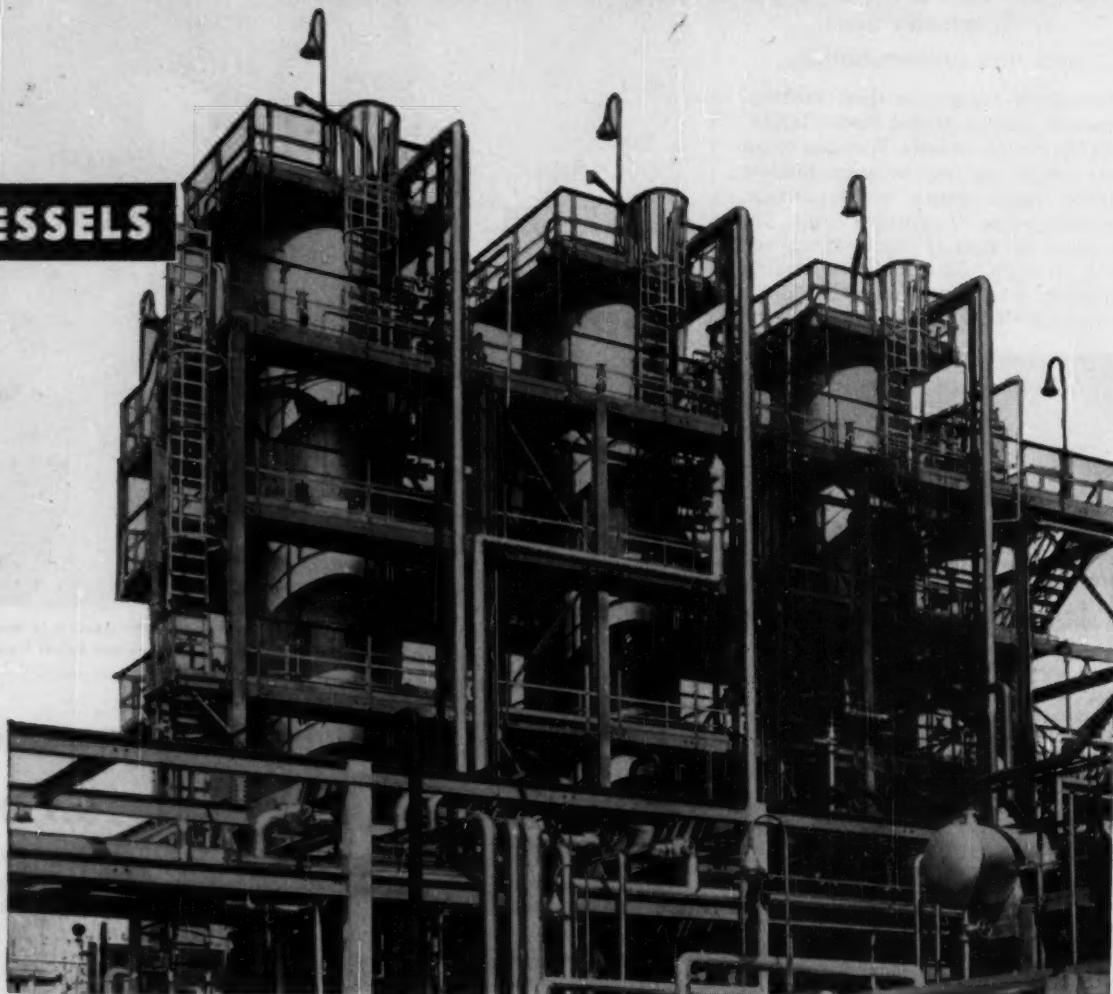
STREET \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_

TYPE OF BUSINESS \_\_\_\_\_

# How A. O. Smith Texas polymerization REACTORS, HEAT METALLURGICAL

VESSELS



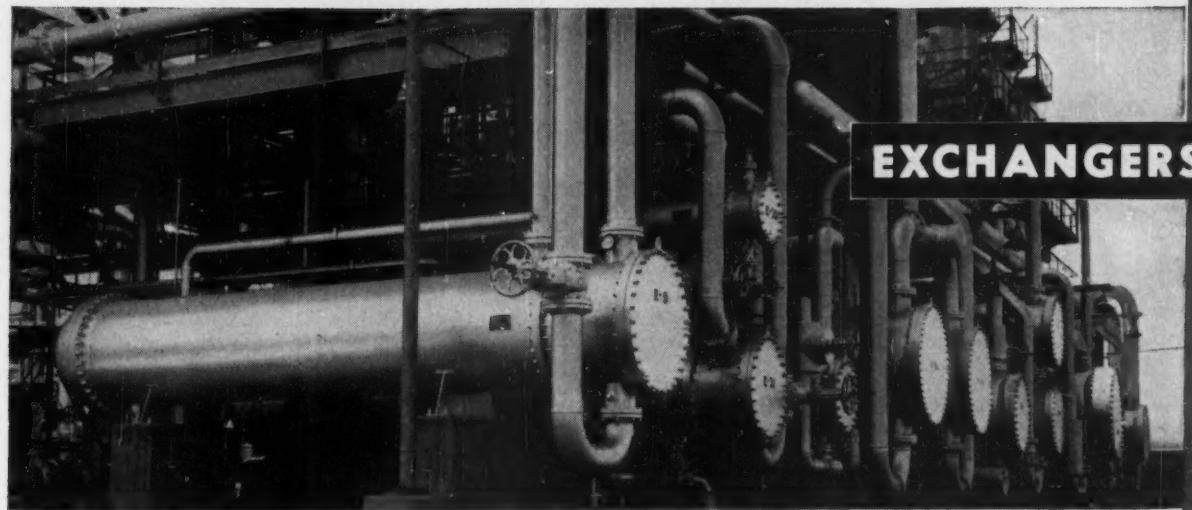
THIS installation shows that A. O. Smith service extends far beyond the usual supplying of vessels and exchangers to order. Here, our metallurgical research served to prescribe the chemical specifications used by the customer to improve the corrosion-resistance of specific reactor linings.

A. O. Smith supplied special pressure vessels, as well as five different kinds of heat exchangers for the phosphoric acid polymerization unit.

This typical example shows why the petroleum, petro-chemical and chemical industries bring their pressure vessel and heat exchanger problems to A. O. Smith.

*Investigate A. O. Smith's performance* in terms of your own processing needs. Write our nearest office. We'll be glad to give you detailed information about A. O. Smith pressure vessels and heat exchangers, engineering and research.

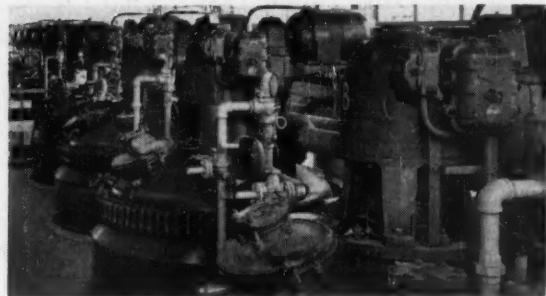
# serves refineries unit uses **EXCHANGERS AND RESEARCH**



## EXCHANGERS

Three A. O. Smith reactors with type 316 ELC lining are the heart of the unit. Designed for operating pressures of 640 psi, the vessels have 102-in. ID . . . are 58 ft. long with 2 $\frac{3}{8}$  in. wall thickness.

The unit has 21 A. O. Smith heat exchangers. These include reboilers, condensers, coolers, heaters and exchangers, ranging in diameter from 15 to 51 in. We make all types of heat exchangers required by a petroleum refinery.



**Broader service through Glascole** — For more than 20 years, our subsidiary, Glascole Products, Inc., Cleveland, has been serving the process industries. Glascole can supply you with corrosion-resistant laboratory and pilot plant reactors . . . single-shell or jacketed storage tanks . . . double-jacketed condensers . . . columns.

Through research  ...a better way

**A.O.Smith**  
CORPORATION

MILWAUKEE • HOUSTON • LOS ANGELES

Glascole Products, Inc., Cleveland, Ohio  
International Division: Milwaukee 1

## Employment Prospects for 1955



Bright to bleak depending largely on age.



Excellent, as always, for management-ready men.

At first glance, the chemical engineer's job outlook in 1955 appears much the same as in '54. But a more penetrating look reveals a few new factors and some developing trends which give the picture new dimensions.

In store for '55 are

- Continued industry expansion at only slightly below the 1954 level.
- Changes in the draft law.
- More problems for older engineers.
- Increased organizing activity by the engineer unions.
- Diversion of more and more chemical engineers to atomic energy work.

Here's how the manpower supply-demand situation for each age group shapes up in 1955.



### OUTLOOK: Sunny For 20-yr. Olds

The engineer in his 20's is the one they're talking about when they bring up the engineer shortage. If he graduated in the past three or four years he probably had his pick of several job offers, and if he isn't satisfied with his present job he'll have no trouble switching to another in 1955.

Virtually every chemical company is seeking to augment its staff with young engineers. And engineering employment services report an increasing number of calls for engineers with three to seven years experience.

Supply of fledgling Ch.E.'s will be down slightly in '55 (and enrollments continue to drop). Again, the draft,

ROTC programs, graduate schools, AEC and government needs will make inroads on the number available to industry. Industry's demand for fresh-from-college men is expected to climb slightly, too. Net result: Better than ever for job hunters.

► **Military Drain**—Draft calls now run about 23,000 per month—up from 18,000 in early last year. And occupational deferments are a good deal harder to get—and keep. They've been dropping at a rate of about 900 per month.

"Selective Service" is now "Universal," both in name and fact. Lewis B. Hershey, the draft director, has repeatedly indicated that the draft board's function is only to determine when an individual should serve—not who should serve. The latter decision was made by Congress in 1951, and has not been changed since.

Two bills, one to amend the Universal Military Training and Service Act of 1951 and the other to amend the Armed Forces Reserve Act of 1952, were introduced in the 83rd Congress in an attempt to restore the selective provisions to the law. Both languished in committee and died when Congress adjourned.

With the present draft law due to expire in June, new attention will be given to the problem. Early in '55, the President is expected to send an omnibus bill covering military manpower recruiting, training, use and reserve disposition to Congress. The bill will get a rough handling in Congress but when the new draft law emerges it will probably contain two revolutionary provisions: Universal military training and a selectively recallable reserve. The new reserve setup will aim to dis-

tribute trained manpower more equitably between military and civilian needs.

Current reserve calls are low; rarely involve chemical engineers. ROTC calls, however, are a different story. Nearly 100% of the graduates of army and navy ROTC programs are being taken. About 60% of the air force ROTC men are commissioned, the rest become liable to the draft. Over half of the NROTC men are obligated to serve three years, all others face two years of active duty.

A total of some 6,000 engineer graduates of ROTC programs were called up last year, up a third from the previous year's 4,500.

While chemical engineers are coming back from the service at an increasing rate, separations are still lagging behind inductions.

► **Salaries and Recruiting**—Last year's crop of fledgling Ch.E.'s averaged about \$365 to \$375 per month to start. With starting salaries giving indications of finally leveling off, this year's grads can expect to begin their careers at about the same.

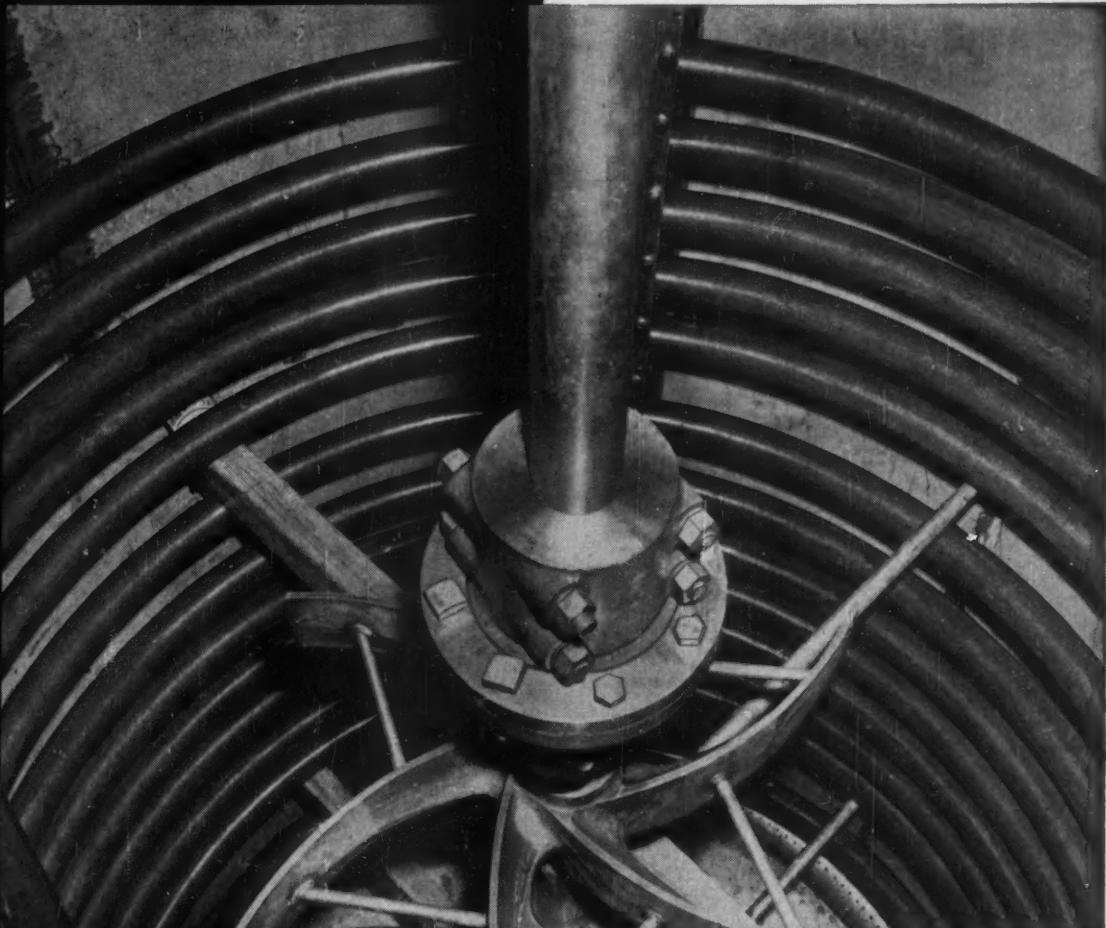
The yearly jumps of \$10-15 in the monthly starting rate, seem to be on the way out, even though campus recruiting is due to reach an all-time pitch.

Recruiters are putting increased emphasis on selling the company and the opportunities afforded by the job. Fringe benefits are also being mentioned more frequently as part of the "sell the company, sell the job" philosophy. But there are some dissenters. A few companies feel "everybody has 'em, so why bother playing them up."

Another note-worthy trend in re-

**Process Purity Maintained . . .  
Fabrication Problems Solved . . .**

**} with Carpenter Stainless Pipe**



Shown above is one section of a 12,000 gallon processing tank for penicillin and streptomycin. In the tank, cultures are heated to 280° then cooled to 55°. The heating and cooling coils had to be easy to clean . . . resistant to corrosion . . . have a low rate of thermal expansion . . . give trouble-free, smooth bending and coiling, and be easy to weld.

Carpenter Stainless Pipe was selected for this job because it's smooth, pit-free, inside and out. It has the proper ductility and temper for easy fabrication. Most important, Carpenter Stainless Pipe and Tubing are uniform, length to length, order to order.

In short, there's a difference in stainless pipe and tubing and Carpenter makes it. Why not put this provable difference to work in your own product or process—see how it can profitably affect your operation. For additional information, write today for the new Carpenter Condensed Data Bulletin and get the facts on properties, sizes, and other technical data.

Or, better yet, call your Carpenter representative or distributor. He'll be glad to give you design and engineering help, or information, without obligation, arrange for quick delivery of the pipe or tubing you need in the quantities you require.

**The Carpenter Steel Company, Alloy Tube Division, Union, N. J.  
Export Dept.: The Carpenter Steel Co., Port Washington, N. Y.—"CARSTEELCO"**

**Carpenter**

**Stainless Tubing & Pipe**

more than corrosion resistance

## This Year, Keep Your Eye On . . .

### Draft Law Revisions

**Present law expires in June. Look for Congress to adopt universal military training and the selectively recallable reserve proposal of the President's Committee on Manpower Resources—but only after much wrangling.**

### Engineer Unions

**Several bargaining successes and a few closer-than-expected defeats in 1954 have combined with a spate of engineer layoffs to strengthen their hand. They'll be more active in '55.**

### High School Science

**Science courses are being sidetracked in most high schools. (Less than 6% of all students study physics.) Main reasons: Lack of both facilities, good teachers. In '55, watch for more industry aid to teacher's colleges and their programs, more part-time work in industry plans for teachers and stepped-up efforts to build student interest in technology.**

cruiting practices is hiring for specific jobs, in place of the mass hiring and later firing common a few years ago.

Though starting rates seem to be leveling off, salaries continue to be good for young engineers. Those with five years experience are averaging \$5,500-6,000 yearly. The \$6,500 mark is passed by many before reaching 30.

placements expected. Company employment directors say that there are plenty of openings for top men, but they indicate that they're getting more choosy in hiring men in this age group. The "right" abilities and the "right" experience for the job are deciding factors.

Although capital expenditures will be down a few percent from last year, expansion is still the keynote in the industry and with budgets still high, jobs are available. It's a matter of a little hunting and a good deal of selling yourself to nab the one you want.

► **Salary Prospects**—With the emphasis on a specific man for a specific job, companies are offering higher salaries and attractive fringe benefits to the "right" man. This spurs job changes and increases competition for jobs.

To combat the trend to switch jobs, periodic salary reviews and adjustments are becoming more common in chemical companies. The result: Salaries are edging upward. It's a much

### OUTLOOK: Fair to Good For 30 to 45's

Moving up a notch to the 30-45 age group, the outlook is not quite so bright. Here, it's entirely an individual proposition. Companies are looking for specific men to fill specific jobs—if you're the man, fine; if not, sorry.

On the whole, though, finding a job shouldn't be too tough a problem. Engineering employment agencies, at least, are optimistic on the number of

slower movement than the spectacular ascent of starting rates, but it is perceptible. In 1955, this trend will continue.



### OUTLOOK: Dreary For the Over 45's

Dark spot of the chemical engineering employment picture is the over-45 group. Manpower experts will tell you that members of this group always have a problem when seeking a job.

Despite his 20-yr. edge in experience, the over-45 will often find himself at a disadvantage when competing with a 25-30-yr. old for a job. The younger man generally has three big advantages: He's learned the latest engineering techniques, he's more adaptable and he'll work for less.

Engineer layoffs in early 1954 hit this group especially hard. Among those let loose were men who hadn't gone as far as their companies thought they should have, those who the company felt hadn't kept up-to-date and those who were deemed to have a low potential for future growth.

On the other hand, many in this group have established reputations and have made it a practice to keep up with the latest in their field. These have no trouble finding employment.

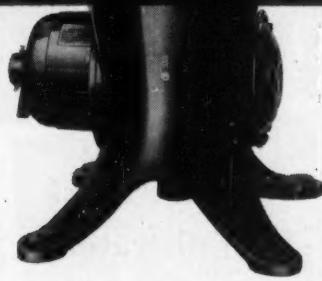
► **Unions More Active**—While engineer unions do not necessarily expect to gain many new members from the ranks of these older workers, their plight will be an important factor in the growth of these organizations. Job security is a prime union goal, and if anything makes the engineer feel less secure in his job, the engineer unions stand to gain.

Flushed with a few complete triumphs, several partial wins and a spate of moral victories in the past 12 months, the unions will renew their organizing activities. And they'll probably have a fair year.

Much will depend on general business conditions. If more unlooked for layoffs occur, the unions will be greatly strengthened.

► **Salaries**—In the over-45 group salaries spread out over a wide range. It's strictly an individual proposition, but

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When a chemical or food processing plant replaces filters or settling tanks with a De Laval Centrifugal, what it really gets is time...time saved!

De Laval Centrifugals make liquid-liquid, liquid-solid or liquid-solid-liquid separations continuous. They do in seconds what would take old-fashioned methods minutes, or even hours—and do it better. They pay for themselves fast, too!

Let us show you, factually, how De Laval Centrifugals have made "stop-and-go" separation, concentration and clarification obsolete in many plants.



**DE LAVAL**  
*for faster processing systems*

THE DE LAVAL SEPARATOR COMPANY Poughkeepsie, New York • 427 Randolph St., Chicago 6 • DE LAVAL PACIFIC CO. 61 Beale St., San Francisco 5

for the overwhelming majority 1955 will bring no increases in income.

Best bargaining hands are held by recognized, and needed, specialists and by men with the experience and other qualifications needed for management posts.



### OUTLOOK: Bright For Management-Ready Men

Throughout the chemical process industries there is a steadily increasing demand for management men with engineering training. According to a recent survey by the Manufacturing Chemists Association some 57% of chemical industry executives have a technical education. And 17% hold degrees in chemical engineering.

At the top-most levels of management, vice president to board chairman, one out of every two executives holds a technical degree, and one of four has an advanced degree.

Management consultants, who often do extensive searching for top-management personnel, report that it is apparent that more, and bigger, opportunities are opening up for chemical engineers at top-level posts.

With more company consolidations than usual last year, there were a number of good, experienced men available. These were almost immediately snapped up by other companies, and 1955 shapes up as another good year for job-hunting engineering executives.

Despite the shortage aspects the emphasis is still on quality. In general, management opportunities are an internal affair. Chemical companies espouse both promotion-from-within policies and executive training programs. When they look outside of the company, again the insistence is on finding the "right" man.

► **Salaries High**—The salary spread for engineers in management is a broad one. Salaries offered depend as much on company size and character as on the engineer's own experience and ability.

Stock options, bonuses, pension plans, expense accounts, etc. are coming to be as important as their salary in the payment of top management. This trend will continue through '55.

## Today's Boss Looks at Tomorrow's

In an article in a recent issue of the *Harvard Business Review*, J. Elliott Janney reports on the reflections of over 200 company presidents who have given a goodly amount of time and thought to the choice of their successor in the company's top job.

What kind of a man does a company president look for as his successor? In general, today's top men hope that their successors will

- Possess a broad background of basic business principles with which to view the many details of the job and sort them into a pattern of comprehensive thought.
- Have the ability to spot the commercial possibilities of scientific developments.

- Be men of ideas who can understand and lead their staffs, as well as men of action who can inspire the line executives.

- Own a sure sense of timing—know when to let the organization coast and when to press for action.

- Be creative thinkers with a lively curiosity and a zest for doing things.

The presidents' had strong views

on the personal characteristics needed by their successors. Motives that are trusted by others, moral courage, an affirmative attitude toward people, and the quality of rational optimism were repeatedly emphasized.

What did they regard as most likely to be helpful in preparing the president of tomorrow for his ever expanding duties and responsibilities? High level job rotation, mingled line and staff experience, advanced management programs, decentralization of authority permitting greater assumption of responsibility and professional psychological consultation were looked upon as likely steps.

Formal qualifications are considered less important than the ability to galvanize other men into practical action and stimulate personal growth of subordinates. Above all, Mr. Janney reports that, "The professional manager of today expects that as a result of study, practice and research the successor of tomorrow will be far more advanced in the art of management than he is."

## To Train Engineer-Administrators

How often have you heard an engineer in an administrative post lament his lack of business and economic know-how? In a YOU AND YOUR JOB survey of chief engineers (Chem. Eng., Oct. 1953, p.284), these subjects ranked right behind human relations in the "wish-I-knew-more" category.

In an attempt to fill this need, the University of Rochester, Rochester, N. Y., has inaugurated a new interdepartmental program leading to a bachelor of science degree in industrial management.

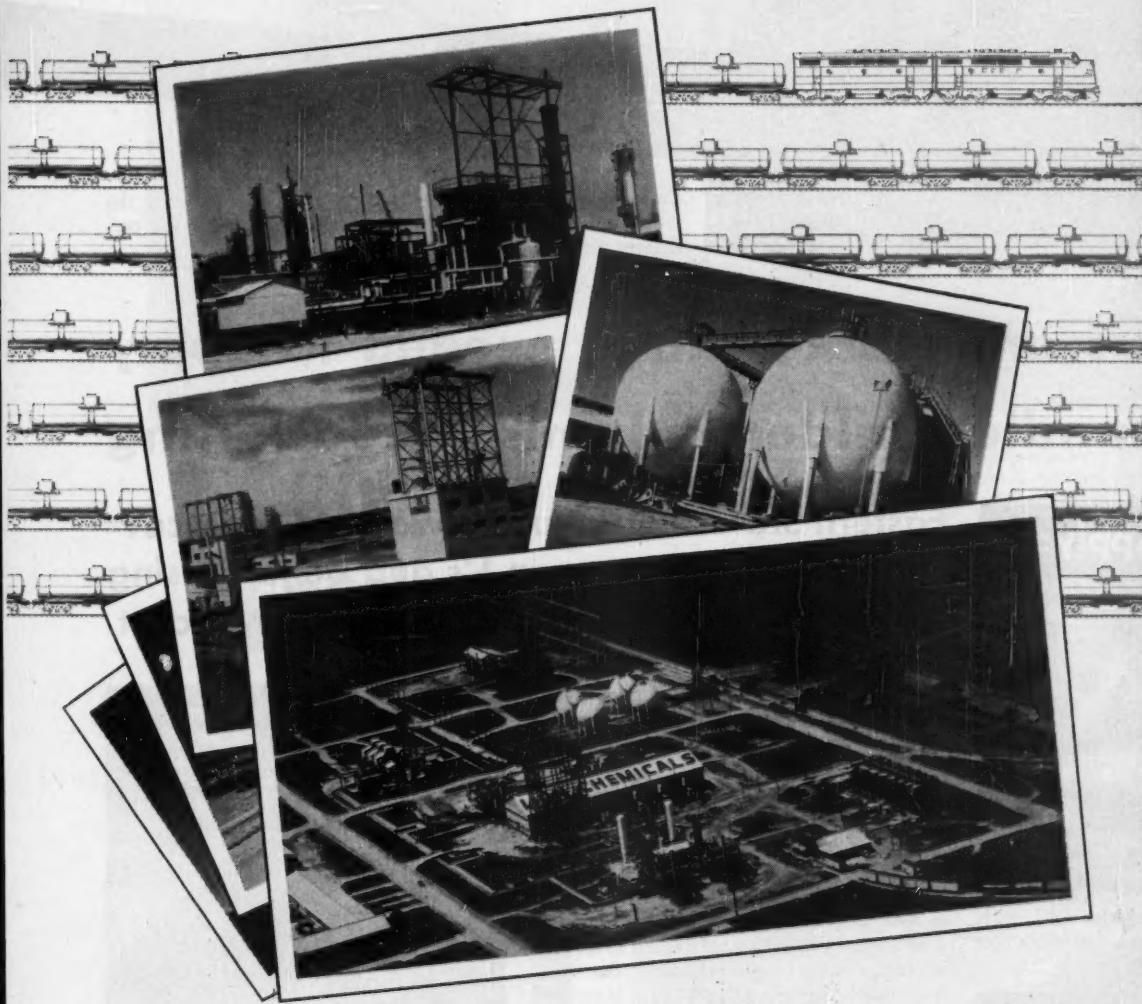
By grounding the student in both engineering and business, the new curriculum proposes to train men for such quasi-engineering work as plant personnel administration, industrial safety and purchasing. Students will earn about 30 credit

hours of study in the basic sciences, 40 in engineering, 30 in social studies and the humanities and 36 in economics and business administration. The program steers a middle-of-the-road course between industrial engineering and business administration.

Dr. Lewis D. Conta, chairman of the University's department of engineering, points out that, "The student will not be an engineer when he graduates, but he will have a thorough understanding of engineers and engineering problems." This, it is felt, will fit him aptly for jobs in those border-line management areas now filled by "men with more than the necessary technical ability, but who are inadequately prepared for the non-engineering aspects of their duties."

# **Another 1,000 tons of NH<sub>3</sub> per day!**

**added to world production  
through Chemico-designed plants  
completed during 1954**



Ammonia plants placed "on-stream" in 1954 for Phillips Chemical Company, Lion Oil Company, American Cyanamid Company, and Sherritt Gordon Mines, Ltd. add more than 1,000 tons daily ammonia production to the already impressive total capacity of Chemico-designed plants.

Chemico provides a *complete* project service in designing the plant, supplying all material, and erecting structures and equipment to produce ammonia from natural gas, by-product hydrogen, or other suitable raw materials.

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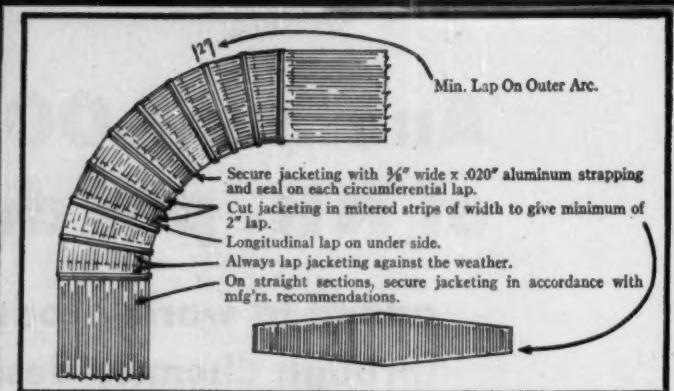
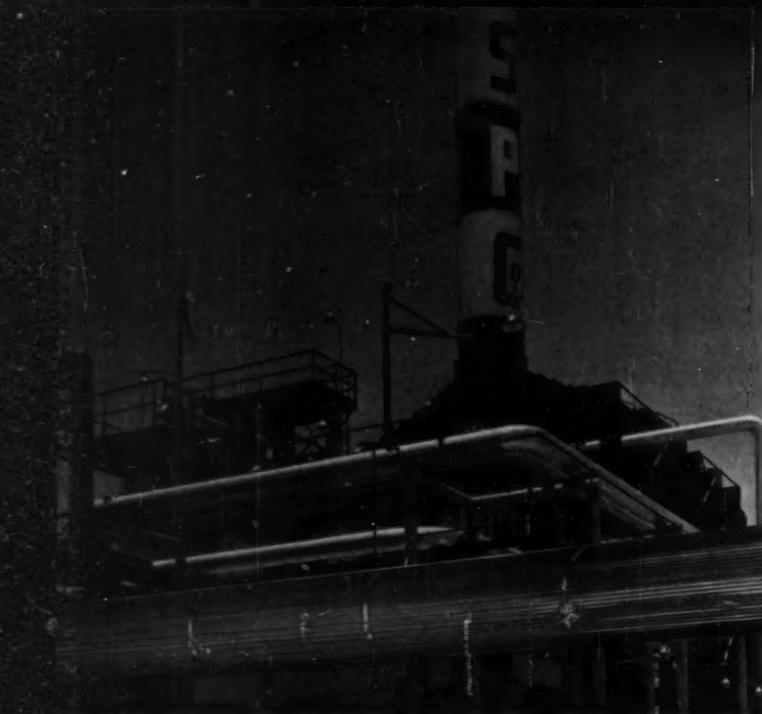
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New method of applying aluminum jacketing over pipe bends with a radius of 5 diameters or more is shown above.

Cutaway view shows how jacketing goes on right over the insulation. Tests show Childers is the lowest cost of any permanent metal jacketing that is available today.

## Only pliers and pocket knife needed to apply easy-to-handle Childers Aluminum Jacketing

### How To Apply:



Best method of applying jacketing is with aluminum strapping and seals. Other method is to use sheet metal screws.



Aluminum strapping can be pulled tight enough with just pliers. Lugs are then bent over and fastening is complete.

Eastern States Petroleum's two-man crew covers insulated lines, even L's and bends—using light-weight, weatherproof aluminum jacket.

**Childers** Jacketing for insulated lines, made of .006" 3S alloy aluminum, was used to cover thousands of feet of line in Eastern States Petroleum's Houston plant.

As it does in over 1000 other plants in all 48 states and many foreign countries, Childers Jacketing helped save Eastern States many expensive hours of application and maintenance time.

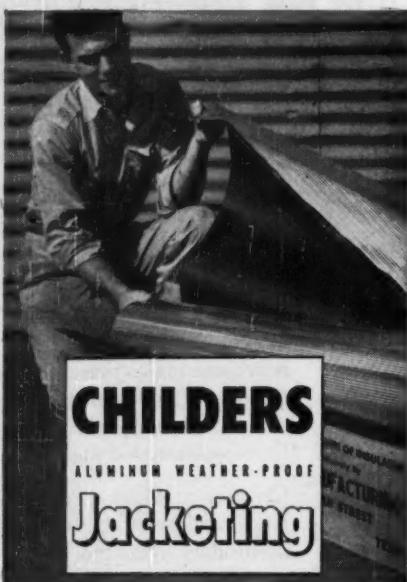
In fact, tests show this: Two men, working with Childers Jacketing for the first time, can cover more feet of insulated line in a day than with practically any other kind of covering. This means real savings in application costs.

The cost is low, too. You can actually put aluminum jacketing on your lines for less than the cost of the cheapest weatherproofing when one paint job is considered.

Immediate shipment from our large factory stocks can eliminate costly delays in construction or plant improvement schedules.

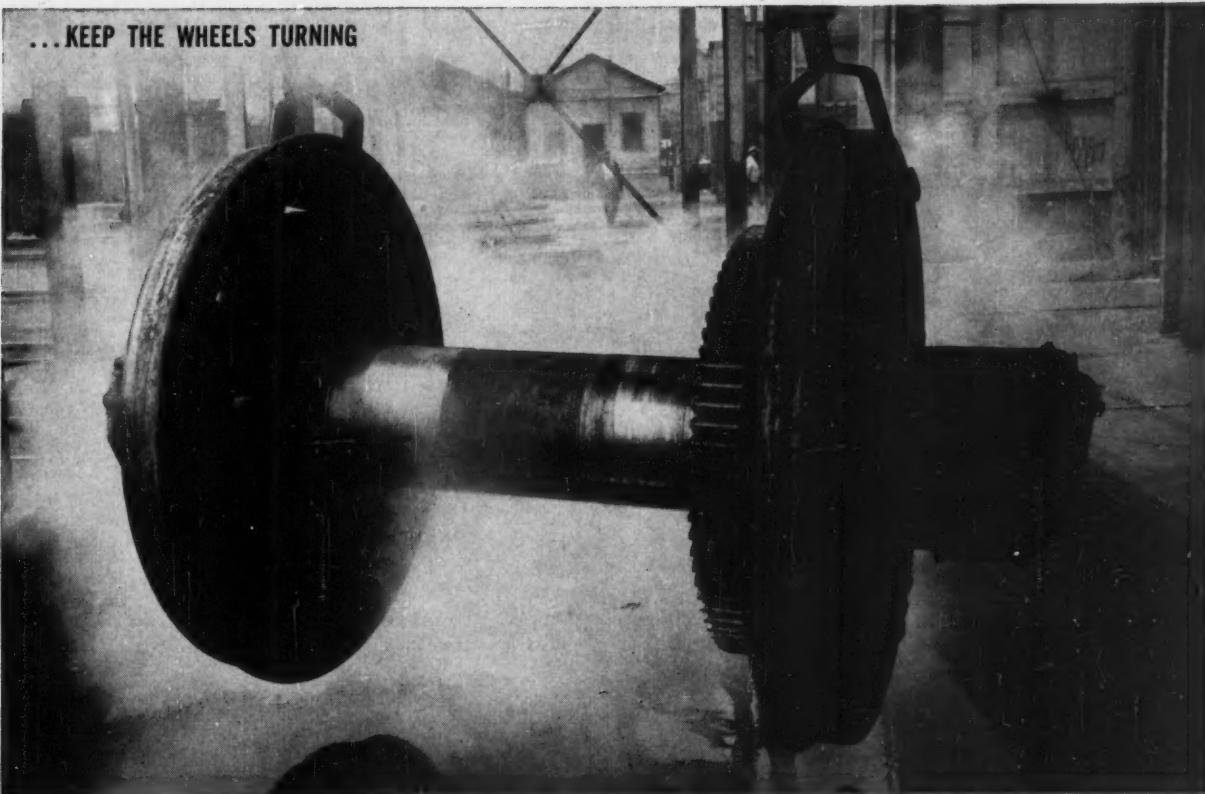
Try this low cost protection in your plant. Write today for engineering data and information about how you can order a 400 sq. ft. roll to test on one of your insulated lines. No obligation. Address: Childers Manufacturing Company, Department CE-9, 3620 West 11th Street, Houston, Texas.

Engineering representatives in most cities to work with you on jacketing problems.



Childers Jacketing arrives on the job in convenient rolls 4 feet wide and 100 feet long—easy for one man to handle. Jacketing comes with or without a moisture barrier attached to the back of the .006" aluminum. Rolls are well protected for field storage if kept dry. Boxes light enough for one man to carry. (Adv.)

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▲ **VERSATILE RAW MATERIAL**—The linters left on cotton seed are made into chemical cotton (bleached cotton linters) by Hercules' Virginia Cellulose Department. In high-grade paper, chemical cotton replaces rags, eliminates costly rag sorting. And chemical cotton is the best source of cellulose, key to products ranging from lacquers to plastics.

▲ **CHEMICAL BATH**—Hercules Dresinate®, added to alkaline cleaners, increases the efficiency of cleaning solutions for large equipment such as these railroad wheels. In other applications—as an emulsifier, detergent, dispersant, foaming and flotation agent—this water-soluble resin helps increase performance, reduce cost of other compounds.



Most businesses are helped today by Hercules' business . . . the production of synthetic resins, cellulose products, chemical cotton, terpene chemicals, rosin and rosin derivatives, chlorinated products, and many other chemical processing materials—as well as explosives. Through close cooperative research with its customers, Hercules has helped improve the processing or performance of many industrial and consumer products. We welcome the opportunity to work with you.

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▲ **IMPOSSIBLE WITHOUT EXPLOSIVES**—Modern highway construction, such as the \$555-million, 427-mile New York State Thruway, would be impossible without explosives. Whether it means cutting through a mountain, spanning a gorge, or even moving a river—the modern highway can go straight and level, thanks to the controlled energy supplied by Hercules® explosives.

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TELESCOPING two-piece hose. Length is adjusted to accommodate height of surge pile.

## Rubber Hose Gets Better

**Availability of newer chemically-resistant rubbers, standardization, and improved designs add up to hoses that are more useful and long-lasting.**

### J. A. MULLER

Recent large increases in the use of rubber hose were sparked by the demands of the war—and made possible by the availability of new rubber compounding ingredients, higher strength reinforcing fibers, and improved manufacturing techniques. The chemical industry is now using millions of feet of industrial rubber hose in a wide variety of standard and special uses.

Standard rubber hose consists

of an inner tube, a carcass of fabric or cord and a cover. Composition of the rubber of the inner tube determines what material can be carried. Kind and the thickness (number of plies) of the carcass limits the pressures. The cover is designed to withstand the various working conditions encountered in industry.

#### Tubes Now Widely Resistant

Significant advances in rubber chemistry have greatly enlarged the usefulness of hose. Rubber in the

tubes can now be compounded to resist attack by oil, butane, propane, acetylene, insecticides, paints, lacquers, mild acids and a host of other chemicals. Hoses are in use for carrying dry and wet solids as well as gases and liquids. Abrasion resistance is built into the tubes.

Hose for carrying steam, hot water or other hot liquids also have heat-resistance incorporated in the rubber of the tube.

#### Carcass Provides Strength

Simplest rubber hose consists of rubber only and is generally used to carry water or air at low pressures. When a hose must carry gases or liquids under pressure, a simple tube is not enough. So reinforcement of cotton, rayon, nylon or steel is wound or braided around the tube. The higher the pressure, the more reinforcement is required. In cases of extremely high temper-

J. A. MULLER is executive engineer, Thermoid Co., Trenton, N. J.

# Corrosion can be controlled



## PREPARING PROTECTION →

A HASTELLOY alloy C safety valve similar to the one being lapped here was inspected recently after handling 500 "pop" reliefs of scalding acid vapors. It was found that the alloy surface still had its original polished finish.

HASTELLOY alloys can help solve your corrosion problems, too. For further information, contact the nearest Haynes Stellite Company office listed below.

## ← COOLING HOT CHLORIDES

Because of its unusual design, this heat exchanger has two to eight times the heat-transfer of plain bare pipe or tubing. HASTELLOY alloy B gives the assembly the necessary corrosion resistance. The exchanger, which was formed from alloy B strip, pipe, and elbows, handles hot chloride-bearing chemicals.



"Hastelloy" is a registered trade-mark of Union Carbide and Carbon Corporation.

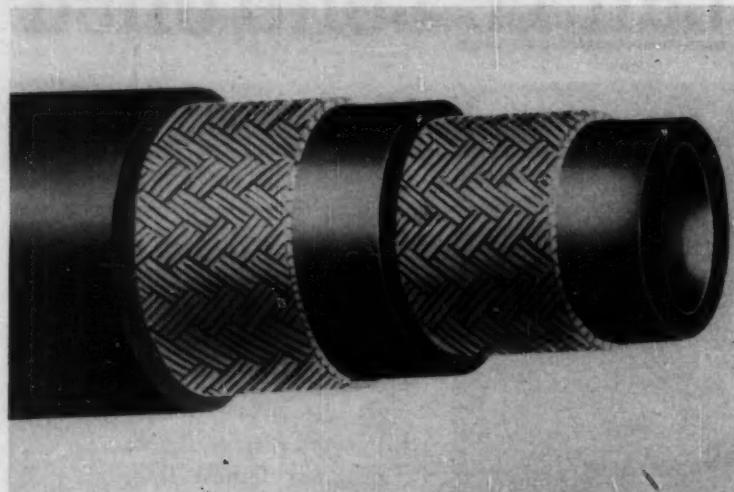
**HASTELLOY** *alloys*  
TRADE-MARK

Nickel-base, corrosion-resistant alloys available as sheet, plate, bar stock, welding rod, welded tubing and pipe; cast pipe and pipe fittings, sand and precision-investment castings.

## Haynes Stellite Company

A Division of  
Union Carbide and Carbon Corporation

UCC  
General Offices and Works, Kokomo, Indiana  
Sales Offices  
Chicago—Cleveland—Detroit—Houston  
Los Angeles—New York—San Francisco—Tulsa



MULTI-PURPOSE 300 psi. hose has carcass of two plies rayon, one ply rubber.

atures of the material being carried or of the working environment, asbestos may be incorporated.

The carcass also enables the hose to withstand excessive deformation under service conditions. In some cases wire reinforcement is interwoven in the carcass to prevent collapse of the hose instead of for burst-resistance.

This type of hose is used mainly in unloading liquids such as fuel oil from trucks. The hose is carried on a reel from which the hose is unwound to reach the tank. The hose is almost never completely unwound. Pressure of many layers of hose on the reel would flatten the hose making passage of liquids difficult or impossible unless the hose were reinforced to hold its round shape under all conditions.

#### Covers Are More Versatile

The carcass must be protected from moisture, abrasion, oil, impacts and sunlight by a cover. The cover also helps identify the hose and makes for better appearance.

What is true of rubber compounds available for tubes is also true for covers. Many more compounding ingredients are available today than a few years ago. Better resistance to wear, petroleum products, sunlight and cuts can now be built into the cover.

#### Two Processes for Manufacture

Rubber hose is manufactured by two processes: long length (lead

press or molded) and mandrel built. Tubes for both types are made by the same extrusion process.

In long length hose, the carcass consists of yarn or cord braided continuously over the tube. The cover is molded on the carcass. The carcass of a wrapped hose is usually fabric of synthetic or cotton yarn wound around the tube, or synthetic or cotton yarn braided around the tube. The cover is then vulcanized to the carcass.

Hose for high pressure and steam service in which either steel wire or high tensile yarn is required for adequate reinforcement is mandrel built.

#### Only Five Types Needed

In the nation's 8,000 chemical plants, industrial rubber hose is frequently used to transfer liquids in temporary or semi-permanent operating arrangements, to unload tank cars into storage or process receptacles, to transfer the contents of other shipping containers into storage or process, to draw test samples from process lines on storage tanks, to facilitate emergency change-overs in process routines, to increase the flexibility of liquid transfer in pilot plant set-ups incident to the development of new production operations, to meet the requirements for flexibility in connection with portable process equipment.

These are what may be termed the standard hose jobs in the chemi-

cal industry. For these uses as many as 18 different types of molded hose were required only a few years ago.

At the present time it is possible to solve 90% of the problems involving industrial rubber hose with only five types. Beginning with the high pressure (800 psi.) hose capable of carrying an extremely wide range of acids, insecticides, gases—the basic five types extend down to the utility hose which is designed to carry only air and water under low pressures.

The 300 psi. hose has had the widest application. It is not unusual to find this hose carrying many different types of materials in the same plant.

In these cases, it is usually possible for the user to buy in large quantities. This simplifies the inventory control problem, reduces the confusion and mistakes in hose selection that formerly occurred, and permits emergency replacement of hose accidentally broken or damaged without serious loss of time. The basic five types are color-coded. Each type has a distinctive color which aids in selecting the correct type.

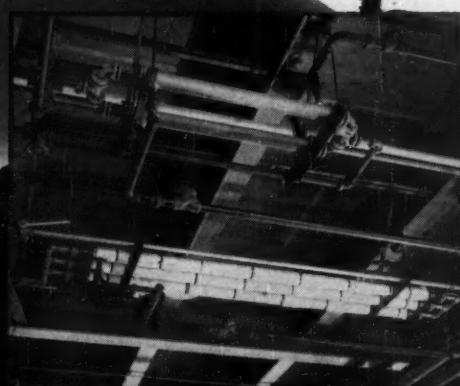
In spite of precautions, heavy vehicles such as fork-lift trucks will run over hose or heavy objects may drop accidentally and break a hose. Transfer of an important ingredient to a processing vessel may be interrupted.

Formerly, chances were that a suitable hose would not be available in inventory at the plant. Even the local jobber may not carry the correct type and size in stock. But, because this modern hose is so versatile, the chances are good that it will be immediately available from plant stock.

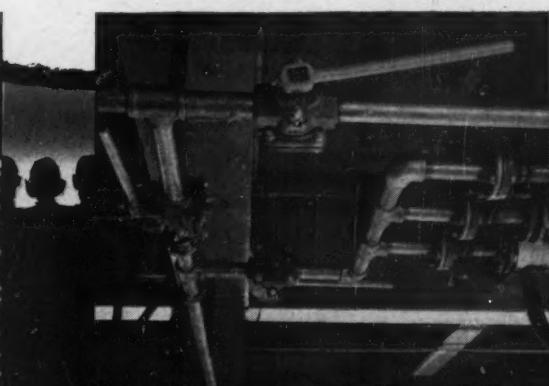
Although the multi-purpose hose has its greatest usefulness in planned or scheduled operations, it has striking possibilities in handling unusual situations.

Suppose, for example, a new vat is being installed in the production line. When the various hose connections are being made, it is discovered that one length of hose has been mislaid or has been forgotten. A call to the plant stock

# THE DURCO STORY AT LINDSAY CHEMICAL COMPANY



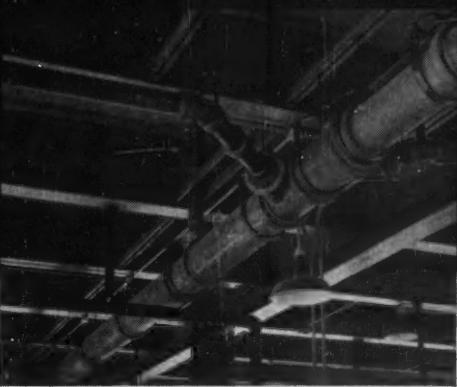
Durco #3C Heat Exchangers (bottom of photo) handling nitrate solutions. (Bulletin M/2) • Durco #4C Heat Exchangers (top) handling sulfuric acid. (Bulletin M/1)



Durco Type F Valves with Teflon sleeves handling nitrate solutions. (Bulletin V/4)



Series R Durcopump (Bulletin P/1) and Durco Type F Valves handling sulfuric acid.



Duriron Acidproof Drain Pipe (3" to 12") handling a variety of waste acid solutions. (Bulletin PF/4)

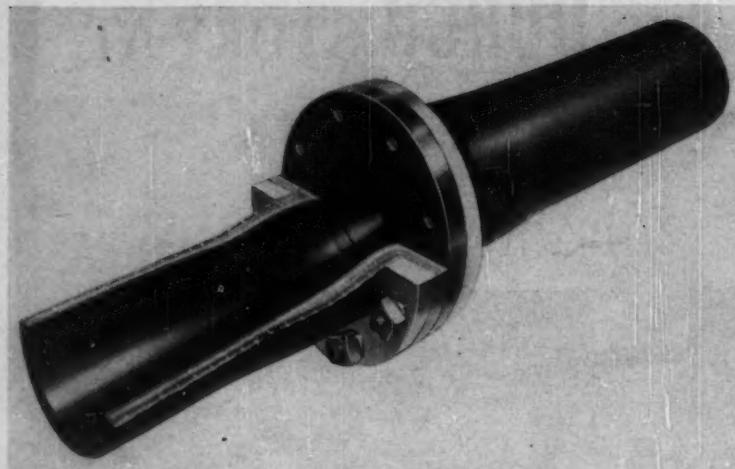
Lindsay Chemical Company is the world's largest producer of thorium and rare earth chemicals. Durcopumps, Durco Type F Valves, Durco No. 3 and No. 4 Heat Exchangers, and Duriron Acid Proof Drain Pipe provide the answers to Lindsay's severe corrosion problems. The Duriron Company and Durco engineered equipment have been serving Lindsay Chemical Company, as they have served most of America's leading manufacturers, for many years.

Durco engineers are located in principal cities to help you solve your corrosion problems. In addition to the bulletins mentioned in the captions, Catalog 54 briefly describes our complete line of alloys and equipment.

We will be happy to send your free copy today.



THE DURIORON COMPANY INC., DAYTON, OHIO



SPECIAL FLANGED COUPLING built integrally with hose.

room will get a suitable hose on the spot in a short time.

Or, suppose a spot fire destroys a length of hose. A replacement can be installed as soon as the fire is out, from plant stock.

#### **Material Handling Uses Broadened**

Present day techniques in rubber hose manufacture make it possible to handle any material that can be pumped. Sufficient bursting strength can now be built into a hose to withstand high pressures by metal or fiber braid reinforcement in the body. Abrasion or chemical resistance can be compounded into the stock from which the tube is made.

Among the many material handling jobs now performed by rubber hose is the pumping of hot asphalt at 400 F. mixed with sand.

In the phosphate mining fields in the south, heavy flexible hose joined together by special rubber flanges provides high capacity with flexibility. Cement rock is pumped along a half mile pier in a rubber hose which is moved from hold to hold in the ships and up and down according to changes in the tide by means of a boom.

Roofing material composed of hot tar, sand and pebbles is pumped straight up to the roof from mixing vats on the ground.

A two-piece telescoping rubber hose has reduced an annoying dust nuisance in stock-piling material with a large percentage of fines (see

cut). A conveyor belt elevates the material to build a surge pile. Dust covered everything and created a health hazard. A metal pipe attached to the bottom of the discharge chute was not satisfactory because abrasion from the material quickly wore out the metal pipe.

Two lengths of large diameter hose similar in construction to suction hose were attached to the bottom of the discharge chute. The larger section of the hose is fitted with a flange at the bottom. Cables attached to the flange and controlled from the hopper raise or lower the hose as the height of the surge pile varies. Telescopic feature of the hose permits depositing the fines directly on the pile with little chance for strong winds to blow the fines over the surrounding area.

#### **Replaces Metal Pipe**

Hydraulic pressure of 2,200 psi caused trouble in actuating 12 individual pistons on a long press when transferred through rigid metal pipes. Vibration caused continuous breakage of the pipes. Twelve short lengths of wire braid hose replaced the rigid metal pipes successfully.

Not only were they able to withstand the pressures involved but they were flexible enough to absorb the vibration which is caused by pulsations from the hydraulic pump as the bottom half of the press is raised.

A centrifugal pump driven by a 15 hp. motor supplies 250 gpm. of cooling water at 120 psi. in a certain process. It was not possible to align the intake pipe precisely with the intake side of the pump.

When using rigid metal pipe, the casting on the intake side of the pump broke frequently because of vibration and stresses caused by the slight misalignment of the pump. The metal pipe was successfully replaced by a length of suction hose built to take the pressures involved and yet flexible enough to absorb the stress of misalignment and vibration.

#### **Hydraulic Control of Machinery**

Development of hydraulic fluids and high pressure hydraulic hose has made possible the precise control of an extremely wide variety of processes and machines.

Whenever it is necessary to operate a machine or part of a machine from a central control point, impulses carried through rubber hose will do the job. Whenever the force required to actuate a part is beyond the normal strength of a person, hydraulic controls are indicated.

Whenever several operations must be controlled from a central point, the use of hydraulic controls should be investigated. Whenever there is a considerable movement of one piece of equipment relative to an attached piece, hydraulic fluid carried through flexible rubber hose may be the best answer to the problem.

Not only will hydraulic hose withstand high working pressures (up to 4,500 psi.) but it resists dimensional changes from extremely high and low temperatures.

There are four principal types of hydraulic hose available today: high pressure (4,500 psi. max.) wire braid hose, a wire braid hose with a cover of specially treated cotton yarn (3,000 psi. max.), medium pressure (1,200 psi. max.) rayon braid hose, and low pressure (500 psi. max.) rayon braid hose.

Operating temperatures for hose of this type range from -40 F. to 200 F. In addition, a special hose with wire spiral reinforcement to

# **CHIKSAN takes a Compressor's Pulse**

## **Keeps Gas Flowing— Absorbs Vibration of Changing Pressures**



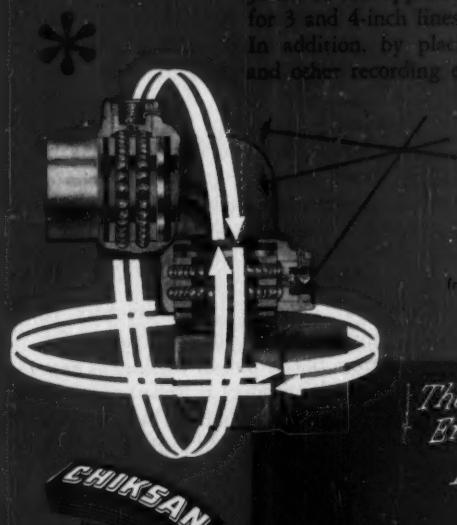
Not only do the stamina and flexibility of Chiksan joints take expansion in their stride, they absorb pulsation and vibration. When the Plymouth Oil Company wanted a better way to handle the expansion and contraction of its 2500-3500 lb. natural gas re-pressuring line in its compressor station in Sinton, Texas, back in 1946, they tried Chiksan 2-inch high pressure ball bearing swivel joints. So successful were Chiksan Joints in this application, they were adopted for 3 and 4-inch lines for the same purpose. In addition, by placing regulators, gauges and other recording equipment on a bridge

using Chiksan Joints, accurate readings of the instruments could be obtained. Since 1946, not one of these Chiksan Joints has been replaced or even repacked, and they are giving the same economical, dependable service they did when first installed.

In Texas or California — all over America and all around the world — wherever production, processing or distribution depends on the flow of liquid or gas or on the dependability of hydraulic systems, there you will find Chiksan Ball Bearing Swivel Joints on the job — adding muscle and flexibility — cutting down on shut-downs and maintenance.

Whatever your business, if gas or liquid plays a part, Chiksan's Research and Development Division can help you add efficiency, safety and economy to your operation.

Representatives in Principal Cities  
Write for Catalog 53-C, Dept. 524



CHIKSAN Ball Bearing Swivel Joints are THE NEW TOOL of Modern Industry — with full 360° rotation in 1, 2, and 3 planes. Over 1,000 different types, styles and sizes have been developed for pressures and services from 20° vacuum to 15,000 psi and for temperature ranges from minus 35° to a plus 500° F. with packing materials for each specific type of service.

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# **CHIKSAN**

*Ball-Bearing  
Swivel Joints*

CHIKSAN COMPANY • BREA, CALIFORNIA • Chicago, 26, Illinois • Newark 9, New Jersey

## CORROSION FORUM . . .

prevent collapse in suction is manufactured to return hydraulic fluid to the hydraulic pump.

### Hose Couplings Keep Pace

Couplings must be selected with as much care as the hose itself.

There are many types of hose couplings available composed of different kinds of metal, built to withstand various ranges of pressure, to provide flexibility if required, in reusable and one-time-use types.

After the correct type for a specific application is chosen, the correct size is the next consideration. Too large a coupling will unnecessarily overstress and weaken the hose while a coupling that is too small will not give a tight fit. Installation of the couplings should be made by experienced personnel equipped with the proper tools.

A special type of coupling has been developed by Thermoid Co. for extremely high pressure work. Designed for oil field drilling rigs to carry drilling mud under test pressures of 5,000 psi. the steel wire wrapping that is a part of the reinforcing carcass of the hose is bonded positively and mechanically to the coupling.

A somewhat larger diameter hose with the same type of coupling is used to carry water at high pressures in the logging industry for removal of the bark from logs by a water jet.

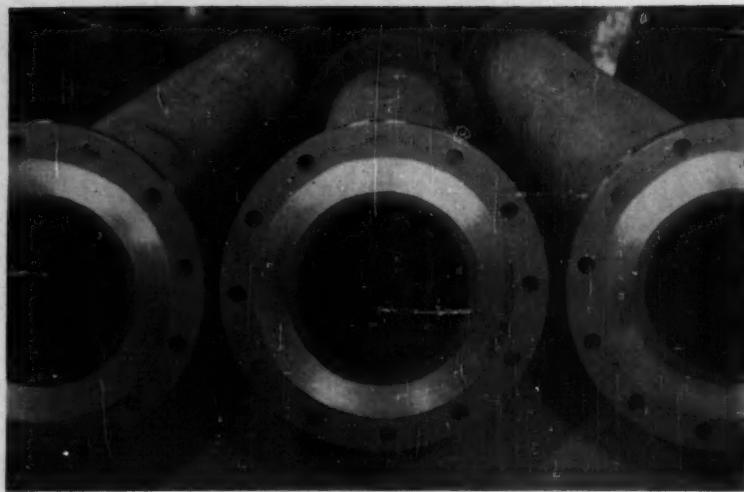
### Special Flanged Hose

In many instances, water or other fluids set up harmful vibration and the "water hammer effect" when pumped through metal pipes.

T. R. Finn Co. has developed a special rubber hose of large diameter (10 in. I. D.) in varying lengths to reduce the noise and vibration carried from the pump to the pipe.

At each end of the hose is an integral flange with a rubber covered metal disc which is used to connect the hose to the flanges of the metal pipes which it interrupts.

Not only does this type of hose reduce vibration and noise, but it prevents galvanic action when used to connect pipes of dissimilar metals.



## Lead Lined Plus

**Inner sheathing of carbon or graphite provides a new material which can be used with erosive, abrasive, turbulent, high velocity liquids.**

Both bonded and expanded lead lined steel pipe process lines are being widely utilized by the chemical process industries for use with sulfuric, phosphoric, chromic, and sulfurous acids, sulfates, sulfites, and the like.

Popularity results from the ability of this piping to withstand severe corrosion at high pressure, temperatures up to 500 F., cycling, vacuum and shock—as well as from ease of installation and satisfactory cost.

However, where abrasion or erosion is present, excessive thicknesses of lead are sometimes needed. This is because frequent removal of the protective salts to which lead owes its corrosion resistance shortens its useful life.

There are also acids and mixed acids other than those previously referred to where lead has a less satisfactory corrosion resistance because the protective salts formed on the lead in contact with these acids are soft and less tenacious. Thus they may be removed by normal

flow too readily, even though the acids contain no abrasives.

To extend the ability of lead lined steel pipe process lines under all these conditions, a new type of pipe and fittings known as sheathed Ferrolum process piping has been developed and standardized by Knapp Mills, Inc., New York, N. Y.

Sheathed Ferrolum pipe and fittings employ a graphite, carbon or impervious graphite liner inserted and cemented into the lead lined steel pipe and fittings which serves three important purposes:

1. The sheathing prevents removal of tenacious protective salts from the surface of the lead. Therefore the product may be employed, even though abrasion or erosion is present. Standard lead thicknesses suffice.

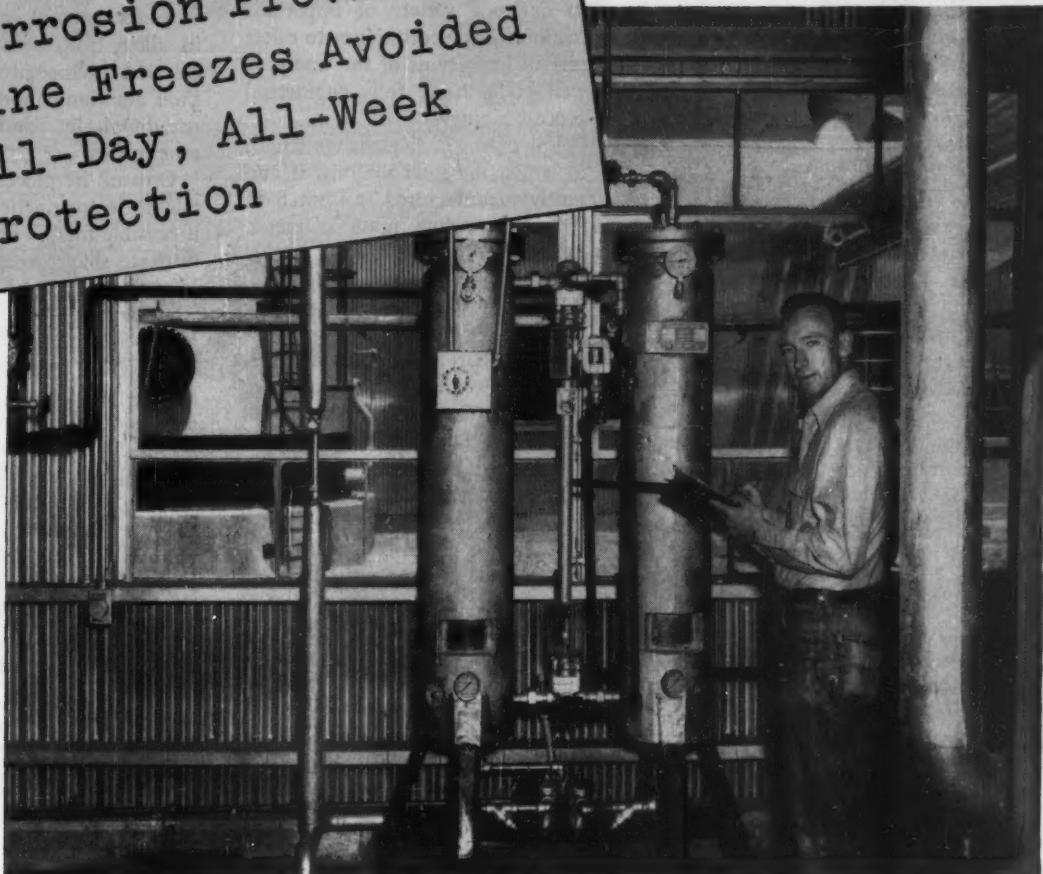
2. Where the lines are used with acids for which lead has less corrosion resistance, the protective salts—although soft in nature—cannot be removed but are trapped between the lead and inner sheathing. Consequently, the life of the pipe

Case No. 108

Seaboard Oil Company Reports:

- Corrosion Prevented
- Line Freezes Avoided
- All-Day, All-Week Protection

Jerry Rea, plant worker, checks on the trouble-free operation of twin towers comprising Kemp Model 50-S Oiled Dryer.



## Sulphur Producer Gets Automatic Drying of Compressed Air with Kemp

During their processing of sulphur and sweetening of natural gas, the Powell, Wyoming, plant of Seaboard Oil Company of Delaware needs large quantities of dried, compressed air to operate complex control instruments.

When their Silvertip Field plant was opened, the operators turned to Kemp to provide this dried air, installing a Model 50-S Kemp Dryer. The machine operates on a manual switching and automatic timing device. Imbedded steam coils reactivate the towers . . . permitting 25 cfm capacity at an exit pressure of 50 psi. The installation is operating 24 hours a day on a seven-day week—preventing corrosion and avoiding

costly delays caused by line freezes in the plant.

If drying air or other gases is a problem in your operation, it will pay you to discuss your problems with a Kemp Engineer. He can recommend specific equipment to handle your specific problem . . . and give you the benefits of every Kemp installation—simplicity of operation and maintenance, low installation cost and minimum maintenance expense. A Kemp Engineer is ready to discuss your needs—without obligation.

For detailed, technical information, ask for Bulletin No. D-29. Write to:  
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## CORROSION FORUM . . .

line is materially improved. In other cases lead may be employed for corrosive conditions which it otherwise might not satisfactorily withstand.

3. The inner sheathing tends to insulate the lead against temperature to a helpful degree and to create a temperature lag where constant cycling is present.

There are two general types of sheathed Ferrolum process piping known as type "K" and type "KM." In type "K", the lead lining is bonded to the steel pipe and thus is employed where temperature cycling takes place. In type "KM", the lead lining is a lead pipe sleeve which has been expanded tightly under hydraulic pressure into the steel pipe. Type "KM" is used where temperature is either low or where temperature is constant for long periods of time.

The graphite, carbon or impervious graphite liner and cement selected is based on the acid under conveyance, process conditions, and economics. Experience with these liners thus far, and in a general way, indicates the following:

Carbon has more porosity than either graphite or impervious graphite. However, porosity is not particularly a factor since the lead lining of the steel pipe provides the corrosion resistance required when erosion effects are minimized. In addition, carbon is the harder material of the three, and therefore resists erosion the best. However, when it is necessary to machine the outside diameter of the sheathings, graphite or impervious graphite are less costly to work with.

All diameters of lead lined steel pipe and fittings up to 12 in. nominal I. D. of the lead lining are produced with inner sheathings. The sheathings, of course, tend to further reduce the I. D. of the process lines, depending on the thickness sheathing selected.

Sheathed Ferrolum process piping is produced in 18 ft. standard lengths for long runs, as well as to detailed bills of material—including lengths of all sizes, spool pieces, etc. Headers, offsets, and other specially fabricated items are generally practical. Fittings, such as

ells, tees, crosses, and laterals are also produced.

In developing, it was necessary to devise a variety of important manufacturing techniques to offset certain limitations of the liners, as well as to insure fully engineered process piping.

For example, the average length in which the liner material is currently manufactured is from 6 to 9 ft., depending upon diameter. Lead lined steel pipe, on the other hand, is manufactured in up to 20 ft. lengths. Therefore, reliable jointing techniques for the liners were necessary. Also, the liner material is not always straight and concentric, so that it was necessary to devise methods of matching or machining to insure satisfactory flow characteristics for the finished piping.

When the liners have been properly selected and prepared, they are coated with cement and inserted in the lead lined steel pipe or fittings. Usually, there is about a  $\frac{1}{8}$  in. clearance between the O. D. of the uncoated liner and the I. D. of the lead lined steel, which space is occupied by the cement. This same cement is employed in making up liner joints, whether in the flanged piping itself or in the flanged fittings. Sheathed elbows are manufactured by mitering lead lined steel pipe.

Experience is now being developed in respect to a procedure whereby the cement is left off the liner material at both ends of the pipe length for a distance of about 2 in. Lead wool is then tightly caulked into this space and the outside lead face of the lead lined flange. The lead wool caulked area is sealed together by the use of a flame. It is felt that this procedure tends to give some resiliency between the liner material and the lead lined steel at the point where lengths are bolted together.

Practice is to insert an acid resisting gasket between the flange face of sheathed Ferrolum. A particularly desirable gasket is that made from Teflon covered asbestos. Full face gaskets from I. D. of sheathing to I. D. of bolt circle are recommended.

## Low Alloy Steels Upgraded, Dollars Saved

A new process\* protects steel and its alloys from both chemical and elevated temperature corrosion. Pure aluminum and its alloys are metallurgically bonded to the ferrous metals.

Crux of the process is a patented salt bath treatment which makes it possible for the first time to coat intricate shapes evenly. Only the simplest forms can be evenly coated by conventional methods. Aluminum penetrates the steel to a depth of 0.0015 to 0.002 in. and approximately 0.0005 to 0.001 in. aluminum remains as a protective coating on the surface.

High temperature oxidation of mild or low alloy steels such as used in oil refinery parts can be stopped or materially reduced. In many cases, costly high alloy steels can be replaced with less costly low alloy steels.

Tests have shown that adequate protection against oxidation is achieved at temperatures at least as high as the base metal has useful strength. Temperatures at which such tests have been made with low carbon steel have exceeded 1,900 F.

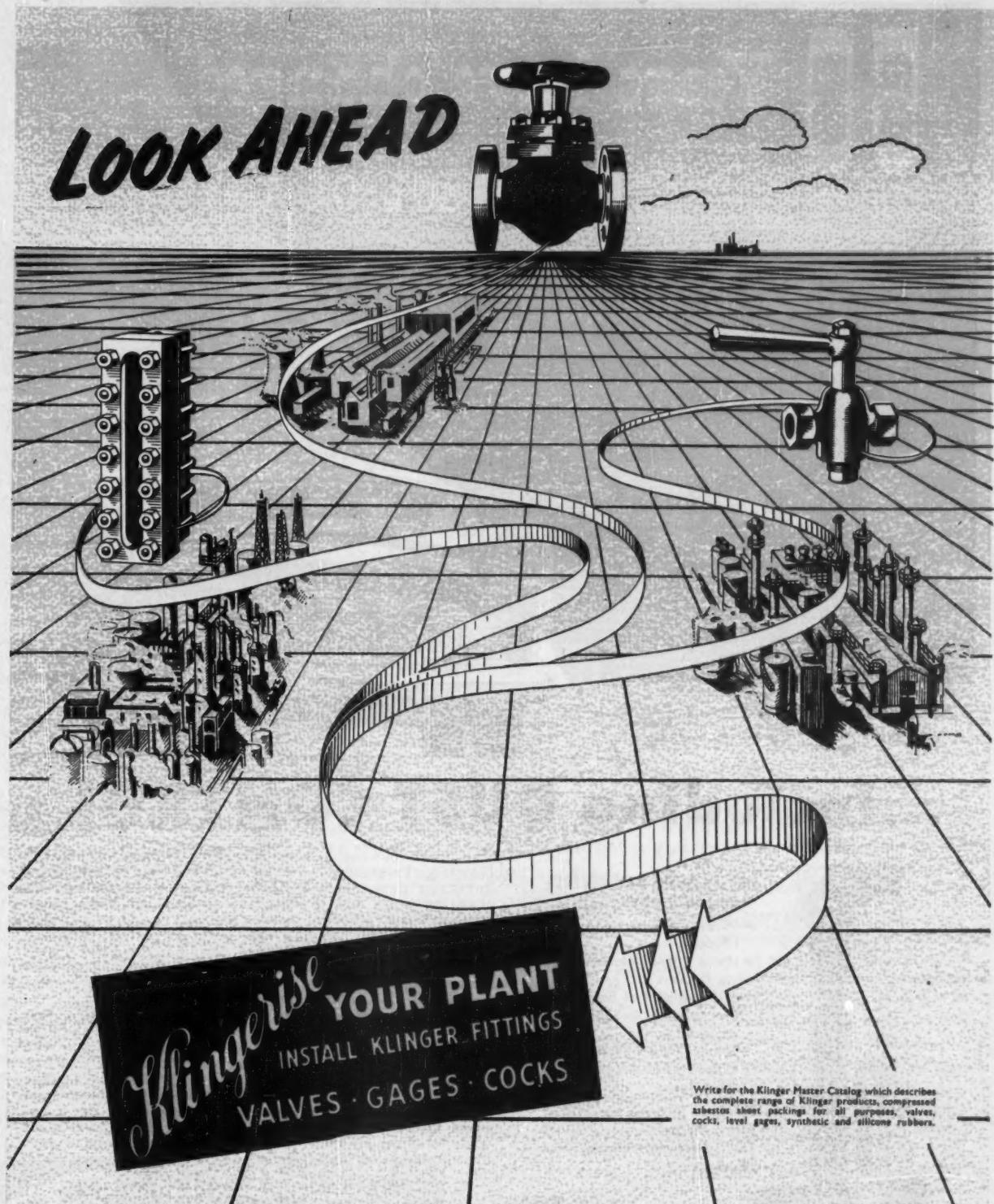
At temperatures exceeding the melting point of aluminum, the aluminum diffuses into the steel forming an alloy. This diffused coating provides a refractory material that gives the steel maximum protection against high temperature scaling.

In preparing metal parts, the areas to which pure aluminum or an aluminum alloy are to be bonded are first thoroughly cleaned. Areas not to be coated are carefully masked off.

Next the metal is put in a salt bath where it is thoroughly wetted. Parts are then dipped in molten aluminum to produce a metallurgical iron-aluminum alloy bond at the interface. Thickness of the coating is determined by the material used and the length of time of immersion.

\* Alumicoat process, Arthur Tickle Engineering Works, Brooklyn, N. Y. General Motors patent.

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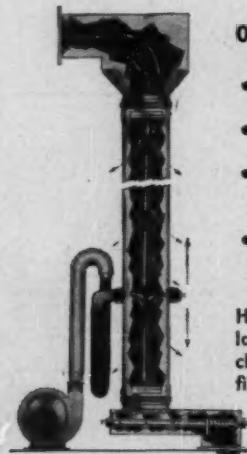
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Handles 5 times more dust laden air per square foot of cloth than conventional dust filters.

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Diagram of operating design of filter tube.  
(Available in multiples of 4, 8, 12,  
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The automobile has changed America's living habits and the DAY High Pressure Reverse Jet Filter has changed American industries' dust control methods. To match the challenge of changing times and changing needs DAY leadership revolutionized the control of dust by utilizing the Hersey principle of filter cloth cleaning with HIGH PRESSURE REVERSE JET AIR. This advanced type of filter handles FIVE TIMES MORE DUST LADEN AIR per square foot of filter cloth than conventional filters. This is the most important improvement in dust filtering in 50 years.

Modern manufacturing methods demand modern dust control methods. There is nothing that will match the high on-the-job efficiency provided by DAY filters. It is a proven fact that one DAY filter recommends another. DAY High Pressure Reverse Jet filtering has been used by leading companies for more than 5 years. 87% of DAY filter users have ordered additional DAY Reverse Jet Filters. For maximum filtering results from a minimum filter investment write for complete facts. DAY gives you tremendous savings in valuable plant space, installation and maintenance costs.

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*If you use filter systems...*

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# OF THE REVOLUTIONARY

# Dualaire\*



# New DUST COLLECTOR!

*No pressure surges!*

*No filter choking!*

*Efficiencies up to 99.99%!*

If you use bag-houses or other similar collecting systems in your plant operations, be sure to investigate the *many* vital advantages built into Western Precipitation's new DUALAIRE Dust Collectors. Backed by the same well-known organization that pioneered commercial application of COTRELL Electrical Precipitators and MULTICLONE Mechanical Collectors, DUALAIRES bring entirely new performance and efficiency standards to filter-type collection systems.

As outlined at the left, heart of the DUALAIRE is a reverse-jet blow ring that travels up and down the cloth filter tube, keeping it clean without the alternate choking and pressure surges characteristic of conventional rapping, vibrating, or jarring systems of cleaning off the collected dust. *Result—*

► **UNIFORMLY LOW PRESSURE DROP** is assured, because the collected dust is removed steadily and in small increments — not by sudden surges!

**► UNIFORMLY HIGH EFFICIENCIES** — as high as 99.99% under actual field conditions — are maintained by the constantly-cleaned filter surfaces. There is no "choking" action — no variation in filter efficiency as dust accumulates!

► **LONGER FILTER LIFE** is obtained because the filter fabric is not subjected to destructive jarring, rapping and vibration of conventional filter cleaning methods. The Dualaire cleaning action is gentle — yet far more effective!

**LESS EQUIPMENT IS REQUIRED** to handle a given capacity with the Dualaire because no standby sections need be provided for gas cleaning while other sections are shut off for running.

The Dualaire filter is kept constantly clean—automatically—while it is filtering out the suspensions. The gas is filtered and the dust removed simultaneously—without interruption. Saves space, simplifies installation!

**MAXIMUM ADAPTABILITY** to varying installation requirements is assured by the "sectionalized" design of the Dualaire. Each section is available in 5 different heights — and as many sections can be bolted together as desired to meet plant requirements. As needs increase, simply add more sections!

► **EFFICIENT STRAIGHT-THRU DESIGN** of filter tubes assures easier dust recovery, better flow. Dirty gas enters top of tube, is filtered through the walls, and dust drops by gravity through bottom of tube into collection chamber. Separated material does not re-entrain in the gas flow.



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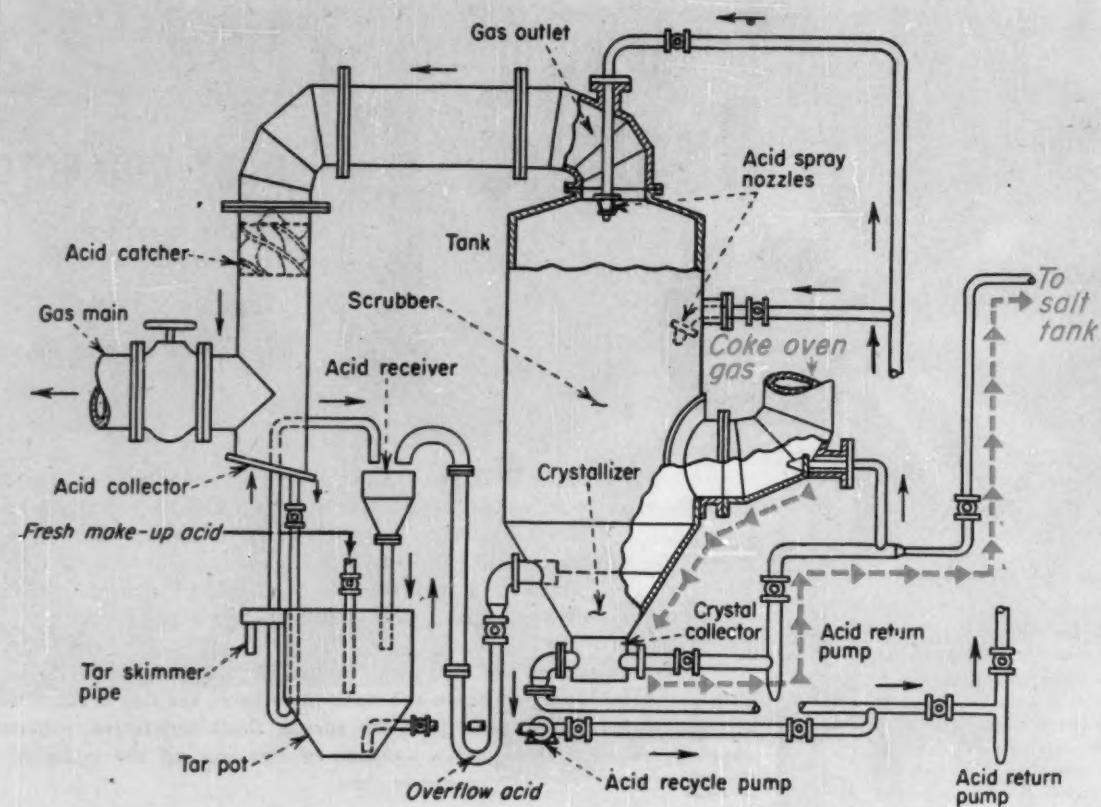
*There are many other advantages built into the DUALAIRE. For further details send for this descriptive 12 page booklet. Or contact your nearest Western Precipitation representative.*

\* "Dualaire" & "Multilone" ©

Licensed by H. J. Hersey, Jr.

# Tomorrow's Technology

Melvin Nord, Chemical Engineer & Patent Attorney, Detroit, Mich.



## New Reactor Scrubs NH<sub>3</sub> From Coke Oven Gas

**Combination sprayer-crystallizer does two-in-one job: scrubs gas with H<sub>2</sub>SO<sub>4</sub>, crystallizes NH<sub>3</sub> as sulfate. Gas separation is almost quantitative.**

Here's a novel reactor designed to effect a quantitative separation of ammonia from coke oven gas.

► **Two-Part Reactor**—The reactor is divided into two sections—the upper, a scrubber; the lower, a crystallizer. Ammonia-containing gas enters near the bottom of the tank; stripped gas exits at the top.

Sulfuric acid is sprayed into the tank top and into the gas inlet. Acid carried over with the gas separates in an "acid catcher." An overflow pipe automatically fixes

the level of liquor and crystals at the bottom of the crystallizer.

► **Acid Cycle**—Gas pressure in the scrubber is sufficiently above atmospheric to blow overflow acid into the acid receiver. Acid collected in the "catcher" also drops—through a closed loop seal—into the receiver.

Next, it flows to a tar pot to which fresh makeup H<sub>2</sub>SO<sub>4</sub> is added. An overflow pipe continually skims tar from the top of the pot. And acid is recycled to the tank top for further use.

To approximate counterflow conditions, it's best to maintain a higher acid concentration at the top of the scrubber than at the bottom. This is done (as shown) by adding fresh H<sub>2</sub>SO<sub>4</sub> to the recycled acid entering at the reactor top.

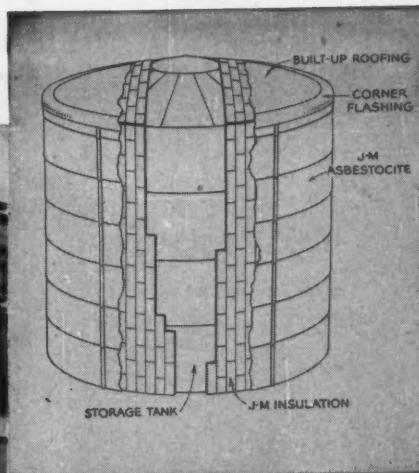
► **Added Features**—In addition to the apparatus shown, provisions are made for:

- Heating the tank wall—to minimize the formation of ammonia sulfate crystals on the inner wall.

- Injecting hot water into the tank and piping—to prevent or eliminate objectionable salt deposits.

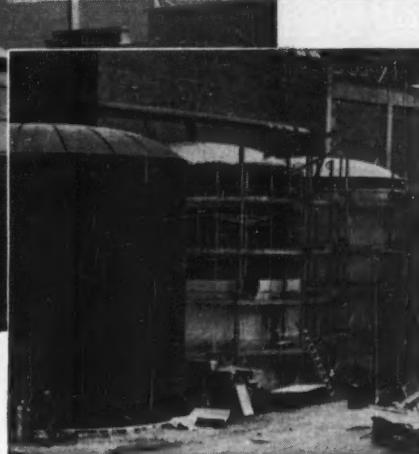
- Adding water—to make up for the evaporation of liquor in the scrubber.

**Cutaway drawing shows how J-M Weather-Protected Insulation** is applied to tanks such as those at the S. D. Warren Company paper mill. Standard methods for mechanical securement of the insulation are used. Asbestocite sheets are then applied over the insulation, in accordance with the simplified Johns-Manville specification.



▲ (Above) Completed job of J-M Weather-Protected Insulation on black liquor tanks of the S. D. Warren Company.

(Right) Skilled applicators of an outstanding J-M Insulation Contractor, P. S. Thorsen Co. of South Boston, Mass., applying Asbestocite sheets over Zerolite insulation.



## S. D. Warren Company saves fuel, reduces maintenance on outdoor tanks with J-M Weather-Protected Insulation

On black liquor tanks of the S. D. Warren Company paper mill at Cumberland Mills, Maine, Johns-Manville Weather-Protected Insulation pays a "double dividend":

**It saves money on fuel and maintenance.** J-M Zerolite\* insulation keeps the heat in . . . thereby saving a substantial amount in fuel costs. J-M Asbestocite\*, a strong asbestos-cement sheet material, covers the Zerolite Insulation to protect it both from the weather and from wetting due to normal plant operations. This "bodyguard" layer of Asbestocite Weather Protection makes the tanks virtually maintenance-free and helps hold down operating costs.

**It helps provide close temperature control.** The temperature of black liquor in these tanks must be maintained so that it will flow freely and not clog up pumping apparatus. J-M Weather-Protected Insulation helps do the job dependably and economically.

Whatever the operating temperature of outdoor tanks and vessels, Johns-Manville offers the right insulation for application under the Asbestocite weather protection. For example, J-M 85% Magnesia Insulation is also widely used for this service because of its proved performance for temperatures to 600 F.

To be sure that the insulation and its weather protection is properly applied to pay the greatest return on your investment, J-M offers the services of experienced J-M Insulation Engineers and J-M Insulation Contractors. These men stand ready to give you an insulation job that will more than pay off your initial investment through maximum fuel savings.

For further information about J-M Weather-Protected Insulation, write to Johns-Manville, Box 60, New York 16, New York. In Canada, 199 Bay Street, Toronto 1, Ontario. \*Reg. U. S. Pat. Off.



# Johns-Manville FIRST IN INSULATION

MATERIALS • ENGINEERING • APPLICATION

## TOMORROW'S TECHNOLOGY . . .

► **Limiting Factor**—Whether the amount of liquor sprayed through the inlet nozzle be less than 3,000 or more than 60,000 gallons per ton of salt produced, ammonia separation is better than 90%.

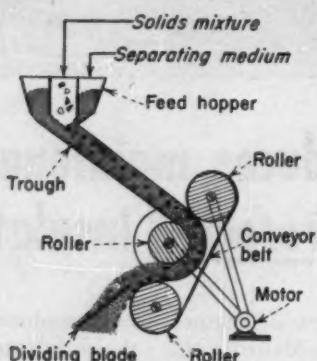
However, to insure separation of all but a minute fraction (less than 1%) of the gas' original ammonia content, the amount of liquor sprayed should be no less than 18,000 gallons per ton of salt produced.

► **Practical Advantages**—These are just two of the advantages offered by the new design:

- At crystallizer pressure of 10-15 psig., gas can flow through the tank at increased mass rates.

- Acid return pumps—i.e. all but the small recycle pump—don't operate against the back pressure of the gas.

For others, see the original patent.  
—U. S. 2,688,533 by Carl Otto.



### New Classifier Separates Solids

Solids of different specific gravities can be separated by directing them down an incline (in the presence of a granular separating medium), then changing their direction of flow. Here's how.

As the solids stream flows down the incline—at an angle greater than the angle of repose—heavier particles sink to the bottom of the separating medium, lighter particles rise to the top.

► **Changing in Mid-Stream**—The upper (lighter) stream flows at a greater velocity than the lower (heavier). Thus the layer of ma-

terial closest to the conveyor belt advances at increased velocity. And separation from the other layer is made easy by using a dividing blade.—U. S. 2,687,804 by Walter Vogel.

### Ethyl Sulfates for Alcohol Production

Mono and diethyl sulfates—suitable for ethanol production—are the end products of this new process involving the two-stage absorption of ethylene in sulfuric acid.

► **Absorber #1**—Ethylene gas flows up through the first absorber, countercurrent to a stream of ethylene and sulfuric acid (chemically combined in a 1:1 molar ratio).

The acid, entering the column at 120-200 F., heats up as it comes in contact with the gas. To dissipate the heat and maintain isothermal conditions, cooling coils are provided.

Finished acid exits from the column bottom, going to a storage tank. This acid is suitable for ether and/or ethanol production.

► **Absorber #2**—Residual gas (70% original ethylene content plus inert) exits from the top of the first absorber and enters the base of the second.

A descending stream of  $H_2SO_4$  strips the gas down to 2-5% of the original ethylene content supplied to absorber #1. The acid stream—a mixture of fresh, 95-100% sulfuric acid and some bottoms from absorber #2—contains 0.4-1.0 mole of ethylene per mole of acid. Remaining bottoms (from absorber #2) serve as liquid feed to the first absorber.

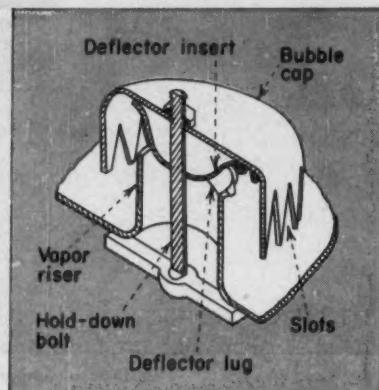
A cooler—at the bottom of absorber #2—removes the heat of absorption from the second column. Both towers operate at 200-300 psig.—U. S. 2,683,731-2 by John S. Atwood to National Petro-Chemicals Corp.

### Polyhydroxy Alcohols From Unsaturated Fats

Here's a new process for converting fatty unsaturates to polyhydroxy alcohols—using persulfuric acid.

The inventor reports no sulfonation, no double bond shifts. Hydroxylation is quantitative.

Spent acid is converted—by anodic oxidation in an electrolytic cell—to persulfuric acid. Fatty material is hydroxylated either in the cell or in a separate reaction chamber.—U. S. 2,688,031 by Roger L. Logan to Kessler Chemical Co., Inc.



### New Look in Bubble Caps

Highlight of a new bubble cap design is a cone-like deflector—inserted beneath the cap—which provides a streamlined path for rising vapors.

With this added feature:

- Coke-like deposits on the threads of the hold-down bolt are eliminated.

- Cap removal is simplified.
- Pressure drop is reduced.

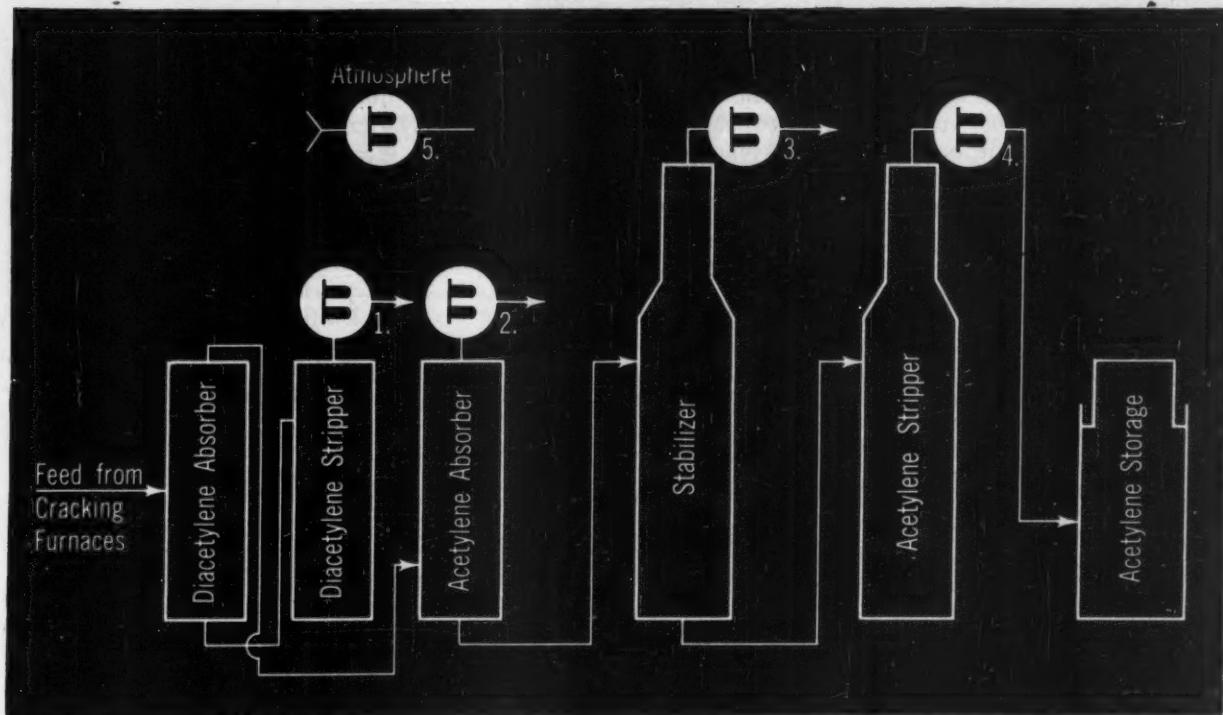
U. S. 2,686,046 by Paul R. Green and Frank J. Chmeil to Standard Oil Development Co.

### Boosting Water's D<sub>2</sub>O Content

Among the several patents on deuterium oxide production recently granted to the U. S. Atomic Energy Commission (see p. 244), this is one worth noting.

► **Deuterium Replaces Hydrogen**—First step in the new process is the contacting of steam with fluidized iron particles (at high temperature and pressure) to produce deuterium-containing hydrogen and iron ox-

**TRUE CONTROL BEGINS WITH ANALYSIS...**



## \***TRI-NON Analyzers Help in Acetylene-from-Hydrocarbon Processing**

New acetylene plants are using newly-developed acetylene-from-hydrocarbon processes. Did you know that continuous analytical control with infrared analyzers can greatly improve your plant operating efficiency? TRI-NON Analyzers in several plants now in production demonstrate this fact.

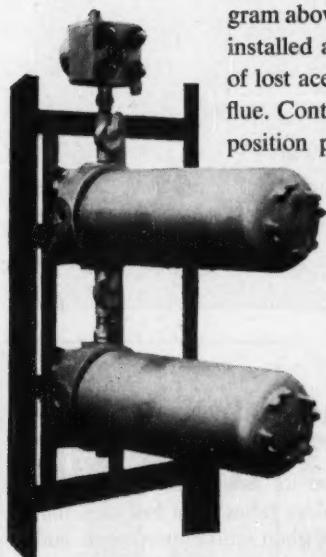
A portion of the purification section of a typical acetylene plant is shown in the diagram above. Analyzers 1, 2, and 3 have been installed at spots where profits, in the form of lost acetylene, might otherwise go up the flue. Continuous knowledge of off-gas composition permits the most efficient adjust-

ment of temperature, pressure and reflux rate. Analyzer 4 performs the highly important endpoint analysis.

To warn of hazardous conditions, TRI-NONS also monitor the concentration of acetylene in the plant atmosphere. They have a sensitivity of  $\pm 1$  ppm in the zero to 100 part per million range.

Let our engineers show you how modern Analytical Control methods can help you increase the profits of your process. Remember—only Perkin-Elmer can provide a complete range of continuous analyzers to meet all applications.

\*TM Perkin-Elmer Corp.



Both the TRI-NON and BICHROMATOR Analyzer continuously record the concentration of any desired stream component. Each is sensitized and adjusted to specific plant conditions before shipping.

**THE PERKIN-ELMER CORPORATION**  
830 Main Avenue, Norwalk, Conn.

Gentlemen:

Send information on the application of infrared analytical control to the following process problem:

Send literature on your infrared plant stream analyzers  
 Have a sales engineer call

Name..... Title.....  
Company.....  
Address.....

**PERKIN  ELMER — FIRST IN ANALYTICAL CONTROL**

## TOMORROW'S TECHNOLOGY . . .

ide particles. Deuterium-rich hydrogen then reacts with water (at reduced temperature and high pressure), deuterium replacing some of the water's hydrogen.

To complete the cycle, iron oxide is reduced back to iron by contacting deuterium-lean gas with oxide particles at high temperature and pressure. Reduced particles are returned to the process.—U. S. 2,689,782 by E. V. Murphree to U. S. Atomic Energy Commission.

### Continuous Methionine Via Nitrile Hydrolysis

Feed producers, please note. A recently granted patent describes a switch in the hydrolysis of methionine nitrile to methionine, an important dietary supplement.

Unlike the conventional hydrolysis (requiring 3 hr.), the new procedure is rapid enough to make a continuous process feasible.

► **Hydrolysis Sans Degradation**—Methionine nitrile is hydrolyzed with sulfuric acid—at 175°C. and under pressure—in a closed vessel. Surprisingly enough, no undesirable degradation products form. (Methionine is thermally unstable above -10°C.)

Product is purified—when pressure on the vessel is released—by distilling off 2–10% (by weight) of the reaction mass.—U. S. 2,688,038 by Richard R. Merner to E. I. du Pont de Nemours & Co.

### Sulfuric Separates Phthalic Acid Isomers

Phthalic acid isomers separated simply and easily. That's the claim of California Research Corp.'s new process for separating terephthalic acid (Mylar intermediate) and isophthalic acid (alkyd resin ingredient).

The new technique does not involve the purification of the acids' precursors, *m*- and *p*-xylene. Rather, it hinges on the separation of the oxidized xylenes by the simple addition of 70 wt. % sulfuric acid.

► **Crystallization**—Upon adding the  $H_2SO_4$ , a solid phase of pure tere-

phthalic acid separates out of solution. Isophthalic crystallizes after cooling and/or diluting the aqueous solution.—U. S. 2,684,382 by William G. Toland, Jr. to California Research Corp.

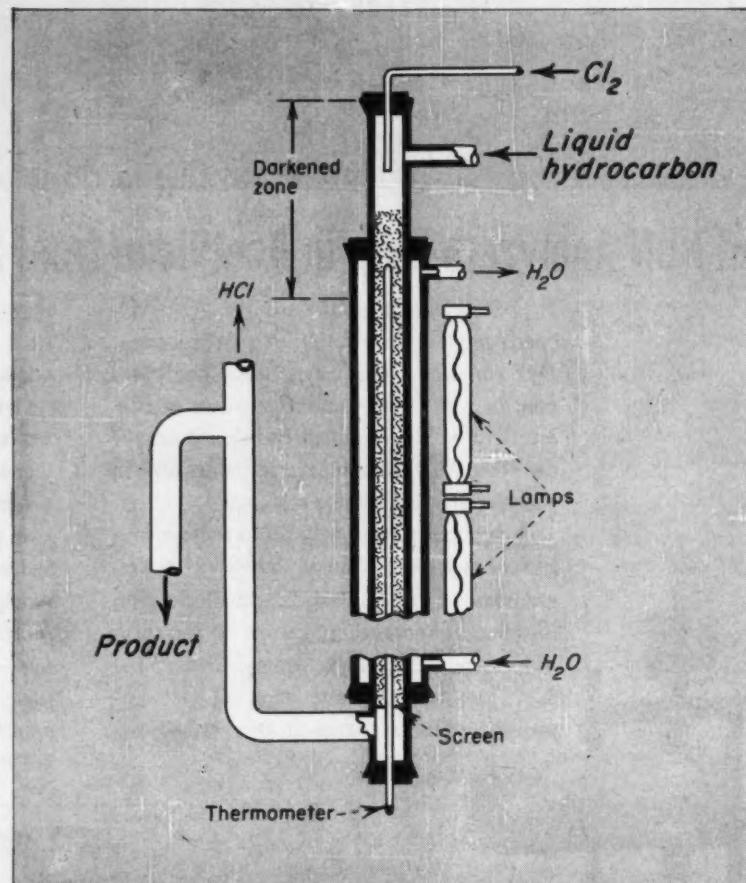
### Alkali Refining Produces Light Oil

Here's a way to improve the color of crude natural oil by a simple alkali-refining process.

Best results are obtained by agi-

tating the oil—with better than 10% aqueous NaOH—at speeds greater than those usually employed.

An agitator having 18 inches of cutting edges per pound of mixture used effects this "shearing together" of oil and alkali. At speeds of 800 ft. per min., emulsification occurs in less than a second. And refining losses are kept to a minimum.—U. S. 2,686,796 by Klare S. Markley and Reuben O. Feuge to Sec. of Agriculture.



### Chlorination Via Photochemistry

Interested in hydrocarbon chlorination? Then you'll want to compare this new process for preparing alkyl monochlorides with conventional methods.

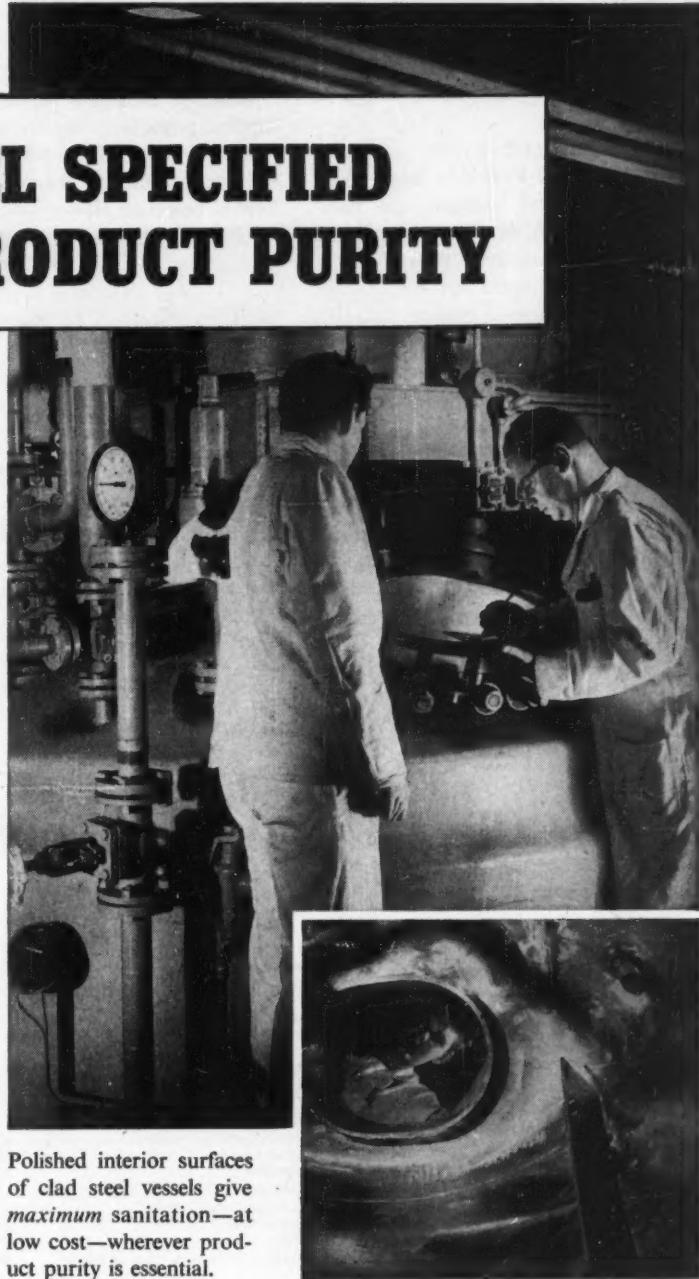
Like its predecessors, the new procedure relies on a low chlorine:hydrocarbon ratio to prevent di- and polychlorination. But it offers these advantages:

# CLAD STEEL SPECIFIED TO GUARD PRODUCT PURITY

Even submicroscopic quantities of foreign bacteria or metallic pick-up are taboo in this antibiotics plant. To safeguard purity *economically*, stainless-clad steel was specified for the 5,000 gallon fermenter, as well as for intermediate fermenters, filter cake receivers and adjustment tanks.

Stainless-clad steel—a layer of solid stainless permanently bonded over its entire surface to a low-cost carbon-steel backing plate—does the work of costly solid stainless plate at considerable savings: polished interior surfaces protect product purity, guard against contamination, are quick and easy to clean . . . completely sanitary. Carbon-steel exteriors are economically painted, too, to help increase plant cleanliness and maintain an attractive appearance.

Whatever demands your processes place on tanks and pressure vessels—product purity, resistance to corrosion, high heat transfer—you'll find clad steel equipment means low first cost and long life. When you're planning new units, call your equipment builder in early. He can give you cost-saving suggestions, help your engineers design equipment to fit your particular needs.



Polished interior surfaces of clad steel vessels give maximum sanitation—at low cost—wherever product purity is essential.

Ask one of your fabricators to show you the new Lukens clad steel movie, "Equip for New Profits." Here—in full color and sound—are factual accounts of how clad steel equipment brings new economies. The story can suggest new ideas to everyone concerned with production efficiency. Or contact Manager, Marketing Service, Lukens Steel Company, 749 Lukens Building, Coatesville, Pennsylvania.

**LUKENS CLAD STEELS**  
STAINLESS-CLAD • NICKEL-CLAD • INCONEL-CLAD • MONEL-CLAD

PRODUCER OF THE WIDEST RANGE OF TYPES AND SIZES OF CLAD STEELS AVAILABLE ANYWHERE

## TOMORROW'S TECHNOLOGY . . .

- Higher equipment capacities.
- Quantitative yields.
- **Illuminated Flow**—As shown, hydrocarbon and chlorine gas flow down—in parallel—through a transparent, illuminated, packed reaction tube. Liquid velocity—exclusive of gas flow—is greater than 10 cm. per sec.

The reaction tube is glass-jacketed, contains glass or ceramic packing. All but the topmost section is illuminated.

► **Reaction Conditions**—Cooling water circulates through the tube jacket to maintain a temperature of 45-65 C. The ratio of chlorine: hydrocarbon is 0.1-0.3 gram-atom per mole. Unreacted hydrocarbon is recycled.

Reaction backup is prevented by supplying reactants—under pressure—through throttle valves. The downward (rather than upward) flow of reactants allows for a longer reaction zone, thus making cooling easier.—U. S. 2,683,688 by Heinrich Tramm, Nikolaus Geiser and Siegfried Puschhof to Ruhrchemie Aktiengesellschaft.

• One pair—above the feed—determines the temperature from one plate to the next.

• The other\* pair determines the temperature gradient below the feed.

Readings are used to control reflux return and heat input to the column.—U. S. 2,684,326 by David M. Boyd to Universal Products Co.

### New Automation for Fractionating Columns

Instead of measuring temperature variations in a fractionating column, a new control measures variations in temperature gradients.

The set-up consists of two pairs of temperature-measuring devices:

This department is designed to keep you abreast of the latest developments in chemical equipment and processes. Any patents may be ordered from the Commissioner of Patents, Washington 25, D. C. The cost: 25 cents.

## Your Checklist of New Equipment Patents

| Operation . . .               | About . . .  | Inventor or Assignee . . .  | Patent No. . . |
|-------------------------------|--|---|----------------|
| Adsorption . . .              | Adsorber for separating gases . . .  | Union Oil Co. of Calif. . . . .   | 2,688,374      |
| Distillation . . .            | Solvent recovery process . . .   | J. A. Bachmann et al. . . . .   | 2,690,019      |
| Drying . . .                  | Fractional distillation with variable reflux ratio . . .                     | Phillips Petroleum Co. . . . .  | 2,690,060      |
| Extraction . . .              | Bubble tower . . .   | Foster Wheeler Corp. . . . .  | 2,690,332      |
| Extrusion and molding . . .   | Dehydrating by freezing . . .  | Commonwealth Engineering Co. of Ohio . . . . .  | 2,683,783      |
| Filtration . . .              | Temperature control for dryers . . .   | Adam E. Armstrong . . . . .   | 2,687,851      |
| Fluid and particle flow . . . | Paint dryer . . .  | John V. Marr . . . . .  | 2,688,068      |
| Heat transfer . . .           | Dryer for granular material . . .  | J. da Oliveira Torres . . . . .   | 2,688,196      |
| Liquid-gas separation . . .   | Conveyor-dryer . . .   | Ferro Corp. . . . . .   | 2,688,807      |
| Mixing . . .                  | Continuous percolation extraction . . .                                      | Michele Bonotto . . . . .   | 2,688,192      |
| Solid-gas separation . . .    | Oil extraction press . . .   | Clarence A. Bowman . . . . .  | 2,687,084      |
| Solid-liquid separation . . . | Liquid—liquid solvent extraction . . .                                       | Phillips Petroleum Co. . . . .  | 2,689,874      |
| Solid-solid separation . . .  | Extrusion apparatus . . .  | Haleo Plastics, Inc. . . . .  | 2,688,769      |
|                               | Molding polystyrenes . . .   | Monsanto Chemical Co. . . . .   | 2,688,774      |
|                               | Injection molding . . .  | George W. Wacker . . . . .  | 2,689,376      |
|                               | Mold clamp for injection molder . . .  | Albert J. Roger . . . . .   | 2,689,978      |
|                               | Horizontal plate filter . . .  | Aloysius C. Kracklauer . . . . .  | 2,687,217      |
|                               | Filter structure . . .   | The Hilliard Corp. . . . .  | 2,687,805      |
|                               | Nomovable disk filter with tipping trays . . .                               | Shell Development Co. . . . .   | 2,687,806      |
|                               | Filter . . .   | Arthur A. Holland . . . . .   | 2,688,406      |
|                               | Suction drum strainer . . .  | Paul G. H. Ohlstrom . . . . .   | 2,689,653-4    |
|                               | Fluidized catalyst stripper . . .  | Phillips Petroleum Co. . . . .  | 2,688,195      |
|                               | Handling gas-particle mixtures in catalytic conversion of hydrocarbons . . . | Deep Rock Oil Corp. . . . .   | 2,688,588      |
|                               | Elevating granular solids . . .  | Sun Oil Co. . . . .   | 2,689,153      |
|                               | Heat exchanger handhole fitting . . .  | Babcock & Wilcox Co. . . . .  | 2,688,315      |
|                               | Fluid heater . . .   | Babcock & Wilcox Co. . . . .  | 2,688,466      |
|                               | Oil refinery heater . . .  | Sinclair Refining Co. . . . .   | 2,688,589      |
|                               | Pebble heat exchanger . . .  | Phillips Petroleum Co. . . . .  | 2,689,047      |
|                               | Heat transfer system using solid-in-gas suspension . . .                     | Thermal Research & Engineering Corp. . . . .  | 2,690,051      |
|                               | Cooler for powdered contact material . . .                                   | Socony-Vacuum Oil Co., Inc. . . . .   | 2,690,056-7    |
|                               | Heater-cooler for liquids . . .  | Pako Corp. . . . .  | 2,690,327      |
|                               | Heat exchanger . . .   | William J. Keesling . . . . .   | 2,690,328      |
|                               | Thermal diffuser-separator . . .   | Walter Wahl . . . . .   | 2,688,404      |
|                               | Liquid homogenizer . . .   | Alpur A. G. . . . .   | 2,690,329      |
|                               | Electrode supports for electrical precipitators . . .                        | American Smelting & Refining Co. . . . .  | 2,688,375      |
|                               | Air scrubber . . .   | Daniel T. Oertel . . . . .  | 2,688,376      |
|                               | Dust filter . . .  | Henry J. Hersey, Jr. . . . .  | 2,689,020      |
|                               | Magnetic separator to remove metal particles from a liquid . . .             | Sundstrand Magnetic Products Co. . . . .  | 2,688,403      |
|                               | Centrifuge for liquid-solid separation . . .                                 | The Sharples Corp. . . . .  | 2,688,405      |
|                               | Centrifugal separator . . .  | Soc. Anonyme des Manufactures des Glaces & Produits Chimiques de Saint-Gobain . . . . . | 2,688,437      |
|                               | Fluid flotation separator . . .  | Allen E. Dillard . . . . .  | 2,689,646      |
|                               | Heavy media separation . . .   | Western Machinery Co. . . . .   | 2,690,261      |
|                               | Heavy media separation . . .   | American Cyanamid Co. . . . .   | 2,690,262      |

FAMOUS LIGHTHOUSES OF AMERICA



*SANDY HOOK LIGHTHOUSE, built in 1764 by the Colony of New York, is the oldest original light tower in use in the United States. A massive structure, octagonal in form with walls of stone seven feet thick at the base, it stands today as it was built except for an added inner lining of brick. This famous lighthouse is located on a narrow peninsula on the New Jersey coast sixteen miles due south of New York City and still helps to guide ships into New York's lower bay.*

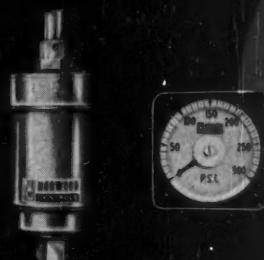
**Sure guidance** for users of electrochemicals is the long-recognized quality of Niagara Alkali products. A pioneer in this field, Niagara has helped manufacturers improve their products and the efficiency of their processes through the use of Nialk® Liquid Chlorine, Nialk Caustic Potash, Nialk Carbonate of Potash, Nialk Paradichlorobenzene, Nialk Caustic Soda, Nialk TRICHLORethylene, Niagathal® (Tetrachloro Phthalic Anhydride).

**NIAGARA ALKALI COMPANY**

60 East 42nd Street, New York 17, N.Y.

# ... And New Process Patents

| Product . . .                    | Process . . .   | Inventor or Assignee . . .   | Patent No.  |
|----------------------------------|---|--|---|
| Dyes . . .                       | Vat dyeing acrylonitrile textiles . . .<br>High-temperature vat dyeing with trialkanolamines . . .<br>High-temperature vat dyeing with manganese cpds. . .  | Deering Milliken Research Trust . . .<br>American Cyanamid Co. . . .   | 2,683,644<br>2,683,645  |
| Fats and oils . . .              | Vat dyeing cellulose acetate . . .<br>Treating glyceride oils and fats . . .<br>Ammoniation of glyceride oils . . .<br>Alkali-refining crude natural oils . . .<br>Separating tall oil into a fatty acid and resin acid . . .<br>Fractionating fatty materials . . .<br>Oil extraction from seeds . . .<br>Producing nitrogenous fertilizers . . .<br>Gasification of solid fuels . . .<br>Air separation . . .<br>Oxygen production . . .<br>Air separation . . .<br>Adsorptive separation of CH <sub>4</sub> and H <sub>2</sub> . . .<br>Thermal working of shale . . .<br>Purifying m-xylene by sulfonation . . .<br>Solvent extraction of aromatics from non-aromatics . . .  | British Celanese Ltd. . . .<br>Byron M. Watson . . .<br>Benjamin Clayton . . .<br>Sec. of Agriculture . . .<br>Newport Industries, Inc. . . .<br>The Chemical Foundation, Inc. . . .<br>Gordon W. MacIlwane . . .<br>Chemical Construction Corp. . . .<br>Otto Hubmann . . .<br>Air Products, Inc. . . .<br>Phillips Petroleum Co. . . .<br>Chemical Construction Corp. . . .<br>Sun Oil Co. . . .<br>Socony-Vacuum Oil Co., Inc. . . .<br>Standard Oil Development Co. . . .<br>Socony-Vacuum Oil Co., Inc. . . .   | 2,686,707<br>2,686,193<br>2,686,794<br>2,686,796<br>2,688,590<br>2,688,626<br>2,689,857<br>2,689,175<br>2,689,786<br>2,688,238<br>2,688,853<br>2,688,854<br>2,689,624-5<br>2,688,464<br>2,688,644<br>2,688,645  |
| Fertilisers . . .                |   |  |   |
| Fuels . . .                      |   |  |   |
| Gases . . .                      |   |  |   |
| Hydrocarbons . . .               |   |  |   |
| Inorganic chemicals . . .        | Volatile fuel from shale . . .<br>Preparing uranium tetrafluoride . . .<br>Hydrocyanic acid production . . .<br>Beneficiation of ores containing KCl and MgSO <sub>4</sub> . . .<br>Hydrogen peroxide production . . .<br>Producing chlorine oxides by electric discharge . . .<br>Concentration of sylvite ores . . .<br>Ammonium phosphate production . . .<br>Raw sulfur purification . . .<br><br>Pure uranium cpds. recovered from ores . . .<br>Hydrazine manufacture . . .<br>Producing deuterium oxide as a source of deuterium . . .<br>Deuterium oxide production . . .<br>Dual-temperature isotope exchange for deuterium concentration . . .<br>Electrolytic production of uranium powder . . .<br>Electroplating germanium . . .<br>Carbonating ammoniacal solutions . . .<br>Fluorocarbon production . . .<br>Acetylating tertiary alcohols . . .<br>Carboxylating phenols . . .<br>Olefin polymerization . . .<br>Preparation of m-nitro-p-toluidine . . .<br>Oxidizing methyl ethyl ketone . . .<br>Thiophenols separated from phenols by selective alkylation . . .<br>1,4-butanediol from tetrahydrofuran . . .<br>Naphthalene recovery by extraction . . .<br>Producing aromatic aminoalkyl amines . . .<br>Alkyl carbonates production . . .<br>Synthesizing carboxylic acids . . .<br>Oxalic acid manufacture . . .<br>Hydrotropic extraction of alcohol . . .<br>Preparation of fluorinated organics . . .<br>Glutamic acid manufacture . . .<br>Carboxylating mixed olefins . . .<br>Production of p-xylene concentrate . . .<br>Photochemical preparation of CCl <sub>4</sub> . . .<br>Maleic anhydride production . . .<br>Sulfonation of alkyl aromatic hydrocarbons . . .<br>Ketene or acetic anhydride production . . .<br>Diketene manufacture . . .<br>Ethyl chloride manufacture . . .<br>Manufacture of dichloropropenes . . .<br>Two-stage olefinic polymerization . . .<br>Hydrocarbon oxidation . . .<br>Polymerisation of olefins using a granular catalyst . . .<br>Separating starch and gluten . . .<br>Production of alkkenyl thiophenes . . .<br>Monochlorobenzene recovery from DDT waste acid . . .<br>Preparing fatty amines . . .<br>Trichlorobenzene manufacture . . .<br>Manufacture of fluorine-containing cpds. . . .<br>Production of titanium dioxide pigments . . .<br>Producing finely divided black cupreous powder for use in anti-fouling paints . . .<br>Manufacture of refractory insulating brick . . .<br>Preparing a magnesia-carbon refractory . . .<br>Preparation of a modified melamine resin . . .<br>Compounding polybutadiene with carbon black . . .<br>Purification of oxo-process aldehydes by distillation . . .<br>Control of hydrocarbon synthesis reaction . . .<br>Treating hydrocarbon synthesis products . . .<br>Hydrocarbon synthesis . . .<br>Hydrocarbon synthesis . . .<br>Solvent dewaxing . . .<br>Solvent refining of wax-containing mixtures . . . | Standard Oil Development Co. . . .<br>U. S. Atomic Energy Commission . . .<br>Allied Chemical & Dye Corp. . . .<br>International Minerals & Chemical Corp. . . .<br>E. I. du Pont de Nemours & Co. . . .<br>Mathieson Chemical Corp. . . .<br>International Minerals & Chemical Corp. . . .<br>Hall Laboratories, Inc. . . .<br>Montecatini Soc. Generale per l'Industria Mineraria e Chimica Anonima . . .<br>U. S. Atomic Energy Commission . . .<br>Olin Industries, Inc. . . .<br>U. S. Atomic Energy Commission . . .<br><br>U. S. Atomic Energy Commission . . .<br>U. S. Atomic Energy Commission . . .<br><br>U. S. Atomic Energy Commission . . .<br>Sylvania Electric Products, Inc. . . .<br>Manganese Chemicals Corp. . . .<br>The M. W. Kellogg Co. . . .<br>Eastman Kodak Co. . . .<br>The Texas Co. . . .<br>Standard Oil Development Co. . . .<br>E. I. du Pont de Nemours & Co. . . .<br>Shell Development Co. . . .<br>Koppers Co., Inc. . . .<br><br>General Aniline & Film Corp. . . .<br>Sinclair Refining Co. . . .<br>G. D. Searle & Co. . . .<br>National Distillers Products Corp. . . .<br>E. I. du Pont de Nemours & Co. . . .<br>Allied Chemical & Dye Corp. . . .<br>Shell Development Co. . . .<br>E. I. du Pont de Nemours & Co. . . .<br>International Minerals & Chemical Corp. . . .<br>Imperial Chemical Industries Ltd. . . .<br>Standard Oil Development Co. . . .<br>Diamond Alkali Co. . . .<br>American Cyanamid Co. . . .<br>Standard Oil Development Co. . . .<br>Allied Chemical & Dye Corp. . . .<br>Farbenfabriken Bayer A. G. . . .<br>Ethyl Corp. . . .<br>The Dow Chemical Co. . . .<br>Standard Oil Development Co. . . .<br>Celanese Corp. of America . . .<br>Standard Oil Development Co. . . .<br><br>Stamicarbon N. V. . . .<br>Phillips Petroleum Co. . . .<br>E. I. du Pont de Nemours & Co. . . .<br><br>General Mills, Inc. . . .<br>Ethyl Corp. . . .<br>The M. W. Kellogg Co. . . .<br>E. I. du Pont de Nemours & Co. . . .<br>H. H. Robertson Co. . . .<br><br>Johns-Manville Corp. . . .<br>Illinois Clay Products Co. . . .<br>American Cyanamid Co. . . .<br>Phillips Petroleum Co. . . .<br>Standard Oil Co. (Ind.) . . .<br><br>Standard Oil Development Co. . . .<br>Standard Oil Development Co. . . .<br>Phillips Petroleum Co. . . .<br>The Texas Co. . . .<br>Standard Oil Development Co. . . .<br>Atlantic Refining Co. . . . | 2,680,787<br>2,688,529-30<br>2,688,631<br>2,689,041<br>2,689,169<br>2,689,217<br>2,689,649<br>2,689,780<br>2,689,783<br>2,690,376<br>2,690,378<br>2,690,379<br>2,690,380-1<br>2,690,382<br>2,690,421<br>2,690,422<br>2,690,431<br>2,684,987<br>2,685,598<br>2,685,600<br>2,686,210<br>2,686,810<br>2,686,813<br>2,686,815<br>2,686,817<br>2,686,818<br>2,687,414<br>2,687,425<br>2,687,432<br>2,687,433<br>2,687,439<br>2,687,440-1<br>2,688,037<br>2,688,042<br>2,688,045<br>2,688,592<br>2,688,622<br>2,688,633<br>2,688,635<br>2,688,640<br>2,688,641<br>2,688,642<br>2,688,646<br>2,689,253<br>2,689,267<br>2,689,810<br>2,689,855<br>2,689,871<br><br>2,690,456<br>2,690,458<br>2,690,459<br>2,689,781<br>2,690,390-400<br><br>2,688,558<br>2,688,562<br>2,688,607<br>2,688,605<br>2,688,591<br><br>2,688,620<br>2,688,630<br>2,689,252<br>2,690,449<br>2,688,587<br>2,689,205-6 |
| Pigments . . .                   |   |  |   |
| Refractories . . .               |   |  |   |
| Resins . . .                     |   |  |   |
| Rubber . . .                     |   |  |   |
| Synthesis gas and products . . . |   |  |   |
| Waxes . . .                      |   |  |   |



**new word**

# ELECTRO-SYN

for reliability  
and ruggedness

in pressure and temperature measurement

ELECTRO-SYN stands for simplicity in design . . . ruggedness in construction . . . reliability in performance. Offering revolutionary advancements in remote indication and control of pressure and temperature, ELECTRO-SYN is available in an explosion-proof construction which permits location in hazardous areas.

NORWOOD CONTROLS ELECTRO-SYN Detectors are based on a unique signal generator. This generator is a high resolution, electromagnetic rotary transducer producing full scale linear output. Fluid pressure in a twisted Bourdon tube, or a temperature sensitive bi-metallic ribbon helix, rotates the signal generator a minute amount, producing a proportional electrical signal.

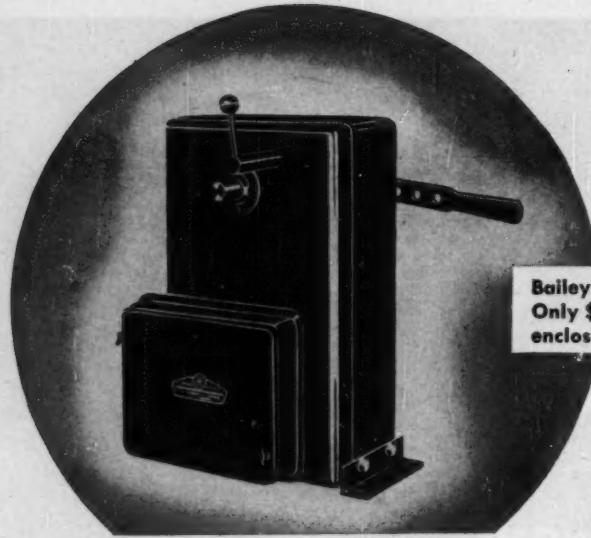
ELECTRO-SYN's exceptionally high output signal, electrically transmitted, makes possible accurate remote readings of temperature and pressure without complex electronic circuits.



Controls Division

**CONTROL ENGINEERING CORPORATION**  
935 Washington Street • Norwood, Mass.

Complete technical information will be supplied upon request



Bailey Control Drive, Type AC44P Model 200.  
Only \$210.00 F.O.B. Cleveland, complete with  
enclosure, positioning relay and hand operator.

## Want Better Flow Characteristics from Your Regulating Devices?

This new, small, piston-operated Bailey Control Drive will improve the flow characteristics of butterfly valves, dampers, hydraulic couplings, feeders and similar regulating devices. Adjustment is simple; any desired relation between drive motion and pneumatic signal may be secured.

You can install this compact pneumatic drive power unit in any position on a column, pipe, or flat surface—and connect it to the regulating device with standard Bailey linkage, available from stock.

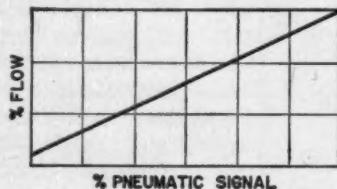
Speed (time required for full travel) is adjustable to suit your requirements. Bailey Control Drives operate on standard SAMA pneumatic signal ranges of 3 - 15 or 3 - 27 psig.

### AVAILABLE FROM STOCK in 3 standard sizes

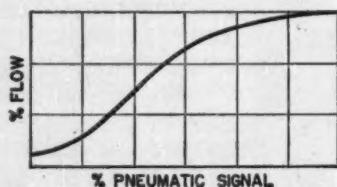
| Type  | Piston Dia.<br>Inches | Piston Stroke<br>Inches | Torque<br>ft-lb | Max. Travel<br>Degrees | Approx. Dimensions<br>Inches |
|-------|-----------------------|-------------------------|-----------------|------------------------|------------------------------|
| AC816 | 8                     | 16                      | 1500            | 90                     | 13 x 27 x 51                 |
| AC68  | 6                     | 8                       | 400             | 90                     | 13 x 19 x 34                 |
| AC44  | 4                     | 4                       | 75              | 75                     | 10 x 11 x 19                 |

P-28

### The New Bailey Control Drive gives you THIS—



### Instead of THIS



**BAILEY**  
METER COMPANY

1054 IVANHOE ROAD

CLEVELAND 10, OHIO

Complete Controls for Process Plants



Controls for

TEMPERATURE  
PRESSURE  
GAS ANALYSIS  
FLOW LEVEL  
RATIO

FOR MORE INFORMATION  
FILL OUT AND MAIL

I am interested in Bailey Control Drives. Mail me Spec. CA404

I am interested in Bailey Control Linkage. Mail me Spec. CA422

Name \_\_\_\_\_

Title & Company \_\_\_\_\_

Street & Number \_\_\_\_\_

City & Zone \_\_\_\_\_

State \_\_\_\_\_

# **Formaldehyde isn't "Formaldehyde" any more**

**It's one of 4 specialized types—  
designed to meet specific needs—  
and only Celanese supplies all 4**

Suppose you're producing a low solids resin for plywood adhesives. Celanese\* Formalin (37% formaldehyde in water) is your best bet. On the other hand, for a high solids urea resin, your Celanese representative can show you conclusive reasons why Celanese Paraformaldehyde (flake 91% active chemical), with its high reactivity, is your most efficient and economical source for formaldehyde.

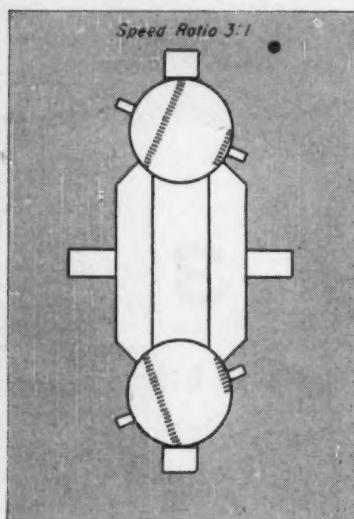
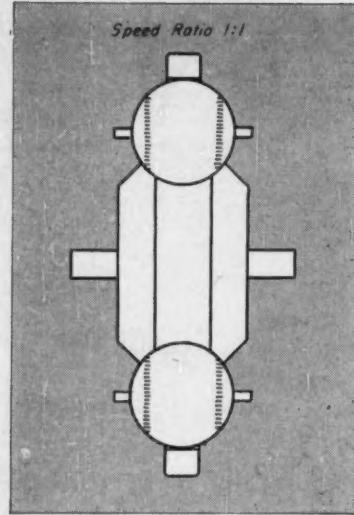
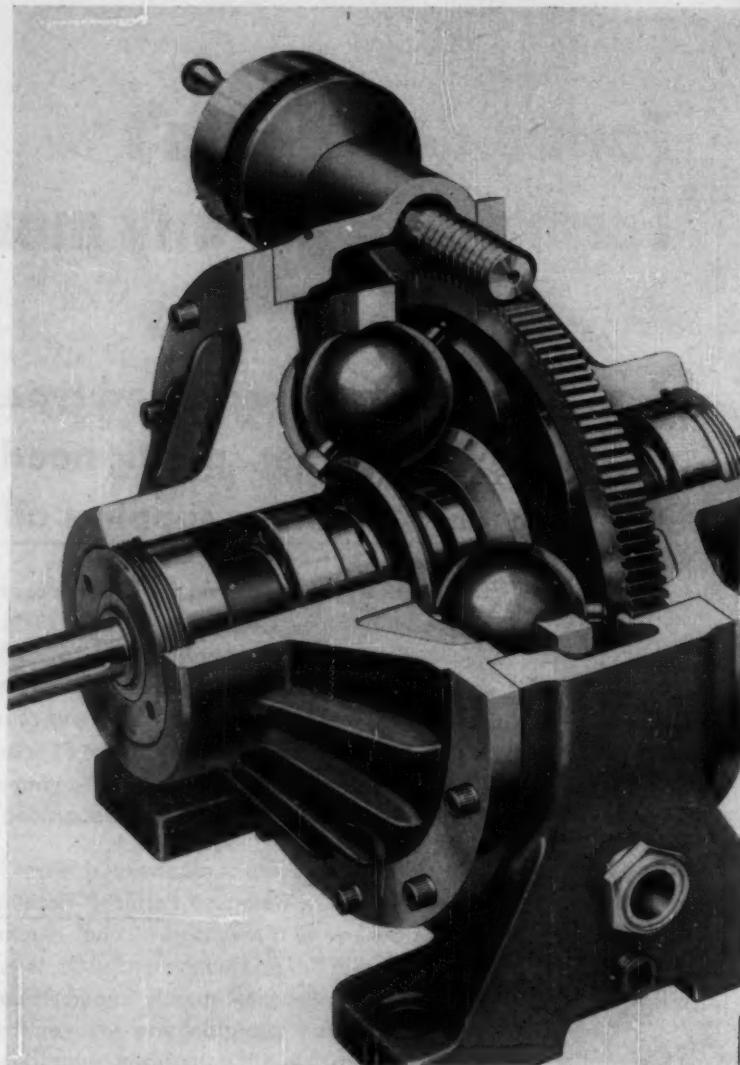
Many producers of alcoholated resins have discovered that a Celanese Formcel\* Solution of formaldehyde in a specified alcohol eliminates a costly step in the production cycle. Or, if you're looking for the most readily available source for dry formaldehyde gas, you'll want Celanese Trioxane, the anhydrous formaldehyde.

The right formaldehyde can give you the competitive edge—through lower production costs and higher product quality. Celanese—formaldehyde headquarters—can help you make the right choice.

Celanese Corporation of America,  
Chemical Division,  
180 Madison Avenue, New York 16.

\*Reg. U. S. Pat. Off.

## NEW ELECTRICAL & MECHANICAL EQUIPMENT



## Ball Transmission Tilts to Vary Speed

**Power is transmitted through rotating balls that can shift position to vary the output speed. Compact, simple unit is 75 to 90% efficient over 9 to 1 speed range.**

At first glance you might think mistakenly that it is a ball bearing. Actually, you are looking at a clever new variable-speed drive, the Speed Variator.

Unit is built with in-line input

and output shafts that provide stepless regulation of output speed from  $\frac{1}{3}$  to 3 times the input speed. The coaxial shafts rotate in the same direction either clockwise or counter-clockwise. A built-in torque-respon-

sive mechanism assures the required tractive force for all operating conditions and high operating efficiency.

► **How Ratio is Varied**—Both input and output shafts terminate in equidiameter circular disks that face each other and are separated by a gap. Mounted in circular fashion between the disks are the driving balls that transmit power from the input to the output shaft.

AT THE FRONTIERS OF PROGRESS YOU'LL FIND



**If you have a special  
grinding problem**

**... CONSULT PURECO  
FOR THE SOLUTION**

Efficient pulverization of dyes, insecticides, fine chemicals and pharmaceuticals requires dry-cool temperatures. PURECO CO<sub>2</sub> — as "DRY-ICE" or liquid — offers many advantages, most important of which are:

- 1 provides refrigeration that removes heat generated by mechanical grinding —
- 2 creates inert atmospheres, thereby permitting grinding with complete safety.

You can improve your "daily grind" . . . eliminate gumming, sticking and lumping—call on our Engineering Service for information about manner and method.

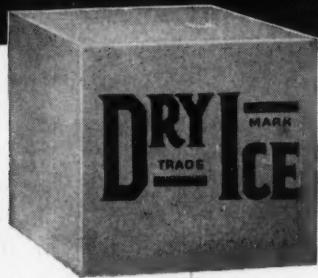
Pure Carbonic Company  
60 East 42nd Street  
New York 17, N. Y.

Yes, we'd like to speak with a Pureco Engineering Service representative about CO<sub>2</sub> in our grinding operations.

NAME \_\_\_\_\_

COMPANY \_\_\_\_\_

ADDRESS \_\_\_\_\_



## **Pure Carbonic Company**

NATION-WIDE "DRY-ICE" SERVICE-DISTRIBUTING STATIONS IN PRINCIPAL CITIES

GENERAL OFFICES: 60 EAST 42ND STREET, NEW YORK 17, NEW YORK

Equipment on these pages made news this month

**Equipment Cost Index, p. 250**

Page number is also Reader Service code number

**New Electrical & Mechanical Equipment**

Ball Transmission ..... 248A

**New Fluids Handling Equipment**

|                              |      |
|------------------------------|------|
| Two-in-One Compressor .....  | 252A |
| Submersible Well Pump .....  | 254A |
| Jacketed Cross Fitting ..... | 254B |
| Jet Siphons .....            | 254C |
| Turbo Pump .....             | 254D |
| Flexible Hose .....          | 254E |

**New Heating & Cooling Equipment**

|                                  |      |
|----------------------------------|------|
| Steam Tmp .....                  | 256A |
| Steam Generator .....            | 256B |
| Liquid Chillers .....            | 256C |
| Drum Dryer .....                 | 256D |
| Resistance Heating Element ..... | 256E |
| Boiler Compounds .....           | 256F |

**New Processing Equipment**

|                           |      |
|---------------------------|------|
| Ceramic Cyclone .....     | 258A |
| Flotation Clarifier ..... | 258B |
| Solids Mixers .....       | 258C |
| Crusher .....             | 258D |

**New Instruments & Controls**

|                            |      |
|----------------------------|------|
| Thermocouple .....         | 260A |
| Controllers .....          | 260B |
| Measuring System .....     | 260C |
| Pressure Transmitter ..... | 260D |

**New Materials of Construction**

|                                |      |
|--------------------------------|------|
| Vermiculite Concrete .....     | 262A |
| Lining System .....            | 262B |
| Stainless Steel Castings ..... | 262C |
| Polyester Resin .....          | 262D |

**New Maintenance Tools & Supplies**

|                            |      |
|----------------------------|------|
| Tube Removal .....         | 264A |
| Thread Compound .....      | 264B |
| Hot Sprayer .....          | 264C |
| Improved Arc Welding ..... | 264D |

For more details, use Reader Service Card

Each ball rotates around its own individual axis.

Relative speeds of the two shafts are adjusted through the 9:1 range by angular positioning of the axles on which the balls rotate. With the ball axes parallel to the shafts (see sketch) the speed ratio is 1:1. To change the speed ratio the axles can be tilted equally in either direction so that the effective rolling radii of the balls with the engaging disks have ratios of 3:1.

Ball positions are adjusted by rotating a slotted plate that supports one end of the ball axles. Close control is obtained by moving the plate with a worm and gear.

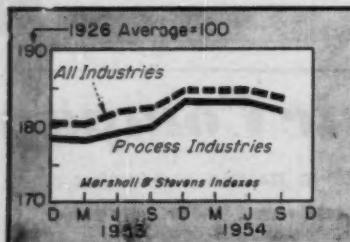
► **Torque Response**—Because of a torque-responsive mechanism between the driveshafts and disks the contact pressure between the disks and balls is only that needed to transmit the torque. And with this design operating efficiencies of 75-90% are maintained easily over a wide range of operating conditions.

Radial force imposed on the driving balls by the disks is countered by the free-floating ring enveloping the balls. The balls are not restrained radially by their axles. Instead they are positioned both radially and axially by the three points of contact provided by

the outer ring and the shaft-mounted driving disks.

Large changes in applied torque produce a slight shift in the position of these free-floating components which in turn produce small inherent speed changes. Over the full range of rated torque, this speed change is approximately 4% which is comparable to the performance of an electric motor. Under constant torque, there is no drift and output speed is maintained without need of further adjustment.—The Cleveland Worm and Gear Co., Speed Variator Div., 3269 East 80th St., Cleveland 4, Ohio. 248A

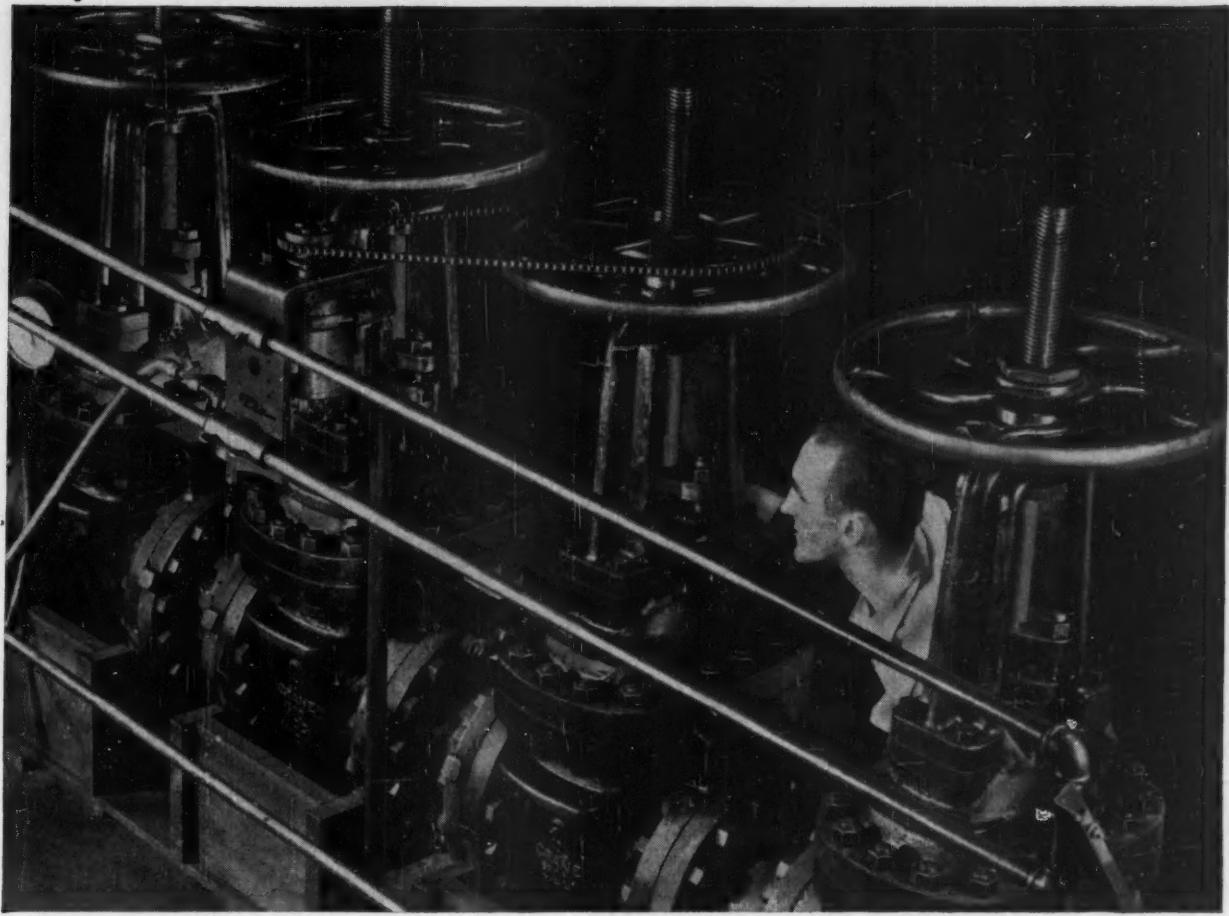
**EQUIPMENT COSTS**



| Process Industries     | June 1954 | Sept. 1954 |
|------------------------|-----------|------------|
| Cement mfg. ....       | 178.0     | 177.3      |
| Chemical ....          | 186.6     | 185.9      |
| Clay products ....     | 172.8     | 172.1      |
| Glass mfg. ....        | 176.4     | 175.7      |
| Paint mfg. ....        | 179.7     | 179.0      |
| Paper mfg. ....        | 180.0     | 179.3      |
| Petroleum ind. ....    | 183.2     | 182.5      |
| Rubber ind. ....       | 185.6     | 184.9      |
| Process ind. avg. .... | 183.7     | 183.0      |

| Related Industries      | June 1954 | Sept. 1954 |
|-------------------------|-----------|------------|
| Elec. power equip. .... | 188.5     | 187.7      |
| Mining, milling ....    | 187.6     | 186.8      |
| Refrigerating ....      | 205.3     | 204.5      |
| Steam power ....        | 175.9     | 175.2      |

Compiled quarterly by Marshall and Stevens, evaluation engineers, Chicago and Los Angeles. See *Chem. Eng.*, Nov. 1947, pp. 124-6 for method of obtaining index numbers; March 1954, pp. 214-6 for annual averages since 1913.



## Testing...testing...50 years and longer to make CRANE VALVES maintenance free

Testing for product performance values is an old custom with Crane. It was started long before many standards existed—long before others in the field used this means of product improvement and quality control.

Today's Crane valve testing is done in both field and laboratory by the most scientific techniques. This continuing work seeks to increase valve performance and lessen maintenance needs. A single example is the stem packing test shown above.

Here's one of the reasons back of the thrifty buyers' preference for Crane valves. They can rely on ever-improving Crane quality to protect their company's investments in piping equipment—especially today, in the face of high maintenance and repair costs. No wonder industry keeps using more Crane valves than any other make.

# CRANE CO.

General Offices: 836 S. Michigan Ave., Chicago 5, Illinois  
Branches and Wholesalers Serving All Industrial Areas

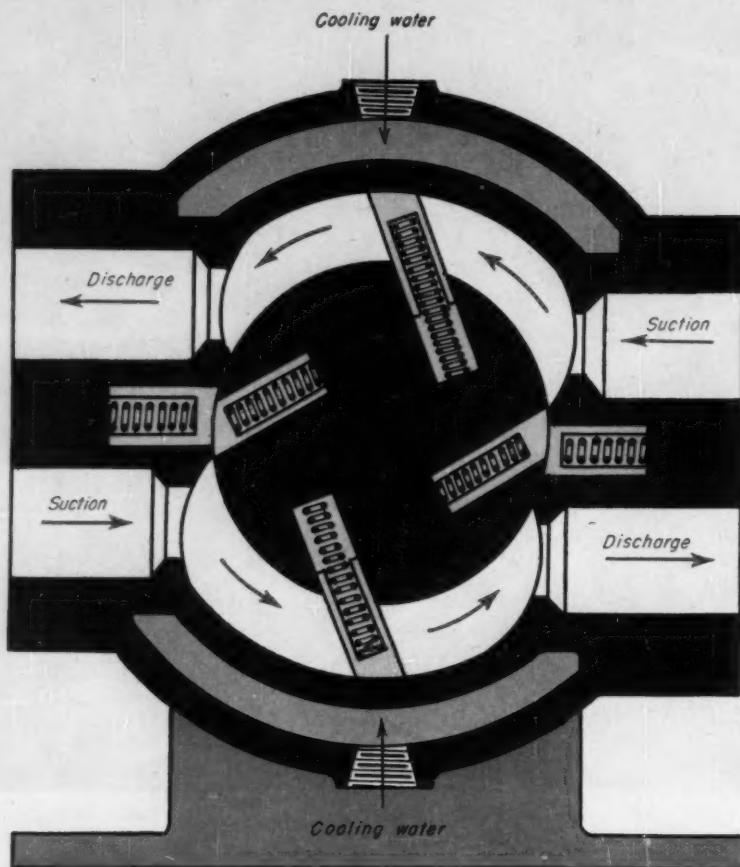
Better Quality  
Bigger Selection  
in Valves  
for Every Need



VALVES • FITTINGS • PIPE • PLUMBING • HEATING

CRANE'S FIRST CENTURY . . . 1855-1955

## NEW FLUIDS HANDLING EQUIPMENT



DOUBLE chamber and sliding-vane rotor cut size for desired output from . . .

## Two-in-One Compressor

**Rotary design achieves high output by using two compression chambers. It is claimed to save space and cost less than others with equal capacity.**

Backed by two years of test runs, this new rotary compressor is now coming off the production line in quantity to meet industrial demand. It is  $\frac{1}{2}$  to  $\frac{3}{4}$  smaller and  $\frac{1}{2}$  cheaper than conventional units with comparable output.

► **Simple Design**—Taking advantage of the basic simplicity of the rotary design the manufacturer is building a unit that does not require oil lubrication, is expected to have particular value where product contamination must be avoided.

Contributing to lower cost are

not only smaller size but also fewer parts. There is a minimum of moving parts so that wear is reduced and maintenance is low. Elimination of chamber lubrication system and oil separator is a cost-cutting factor.

► **High Output for Size**—Unit develops high output at relatively low rotational speed because it is actually a double-acting compressing unit operating off a single concentrically-mounted shaft within one housing. Both sides of the compressor are served by the same rotor

with the same reciprocating blades producing both suction and compression.

According to the inventor, Hans M. Petersen, the shape of the chamber curve leading to the discharge valves is a prime factor in effectively trapping the air between blades and rapidly accelerating the pressure buildup. By blending five curves into one the resultant curve can be followed at high speed by the spring-loaded sliding vanes without losing the sealing action.

► **How Lubricated and Cooled**—The sliding blades and bearings are made of an oil-impregnated, iron-copper alloy. Life tests on the unit indicate capillary action does not bleed the lubricant or contaminate the air. Also, the compressor should operate well under conditions of extreme cold, since there is no oil to congeal.

Although water normally is used as a coolant a self-cooling freon compressor for the refrigeration industry is now abuilding.

► **Standard or Special Drive**—Any conventional gasoline or electric motor can be used to drive the compressor. A miniature, sliding-vane gasoline engine, having many parts interchangeable with the compressor, now is being designed. The combined package of motor and compressor will measure 24 x 9 x 9 in. and weigh about 500 lb. complete.

The current model has a capacity of 120 cfm. and a discharge pressure of 120 psi. Rotor diameter is 4 in., inside bore 6 in. Other models are being designed with bore diameters from 6 to 18 in. for outputs from 30 to 350 cfm. These will be produced as the demand arises.—Petersen Enterprises, 2657 Buchanan St., San Francisco 15, Calif.

252A

### For More Information . . .

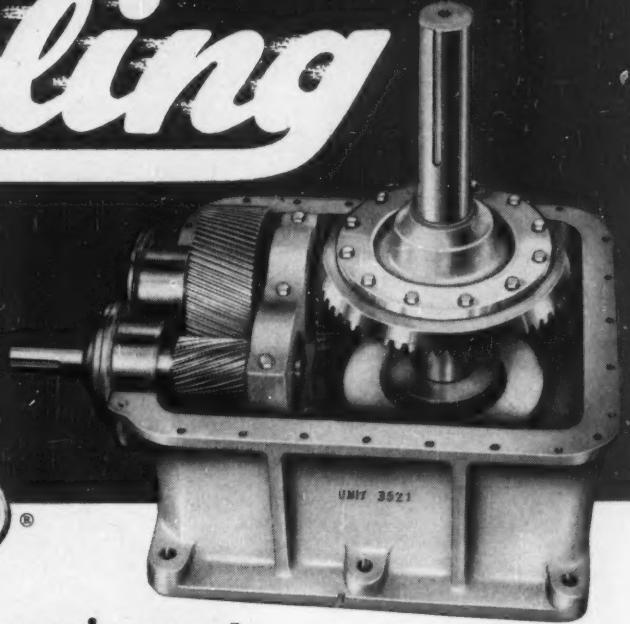


about any item  
in this department,  
circle its code  
number on the  
Reader Service  
Postcard inside the back cover.

# 3 Cooling

## TOWER DRIVES

by



### a type and size for every requirement

The growing use of larger fans in cooling tower service brought the need for a drive that would best meet heavier load conditions. Philadelphia, having long been a leading manufacturer of conventional worm gear cooling tower drives, thoroughly understood this problem and presents a complete line of right angle Speed Reducers . . . Worm Gear, Spiral Bevel, and Helical Spiral Bevel. All three types are specifically

manufactured for cooling tower fan drives. Housings are made of high quality close-grained grey iron and are proportioned to withstand the severe stresses encountered during operation. All shafts mounted in anti-friction bearings to assure high efficiency, correct center distance and proper shaft alignment. Bearings provide generous thrust and radial capacity . . . all these features give long, quiet service life.

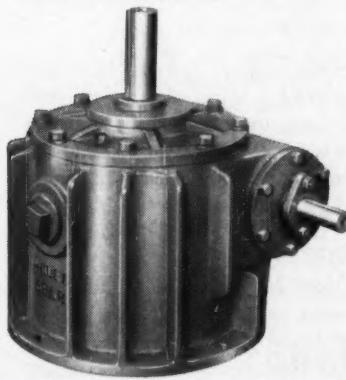
#### worm gear

**HP range**—3 thru 30 HP @ 1750 rpm input.

**Ratio range**—3½ to 8¾.

**Efficiency**—up to 95% depending on ratio.

**Application**—Best economy in range up to 25 HP. Quiet operation, suitable for input speeds up to 2000 rpm.



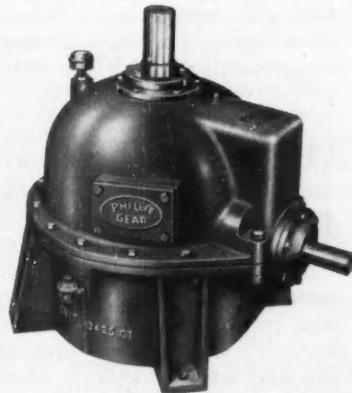
#### spiral bevel

**HP range**—15 thru 75 HP @ 1750 rpm input.

**Ratio range**—3½ to 9½:1.

**Efficiency**—97-98%.

**Application**—Best economy above 15 HP. Advantages of high efficiency, small heat loss. Suitable for input speeds up to 2500 rpm.



#### helical spiral bevel

**HP range**—20 thru 115 HP @ 1750 rpm input.

**Ratio range**—6½ to 15:1.

**Efficiency**—95-96%.

**Application**—Best economy when used on drives greater than 25 HP and when required ratios exceed those possible with single reduction spiral bevel. This unit also best suited for turbine applications up to 4000 rpm input.

**PHILADELPHIA GEAR WORKS, INC.**

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.  
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.  
Virginia Gear & Machine Corp., Lynchburg, Pa.

Write for our new catalog CT-53 illustrating all types of Cooling Tower gear drives and their applications.



Industrial Gears & Speed Reducers

LimiTorque Valve Controls

## NEW FLUIDS HANDLING EQUIPMENT

### Submersible Well Pump

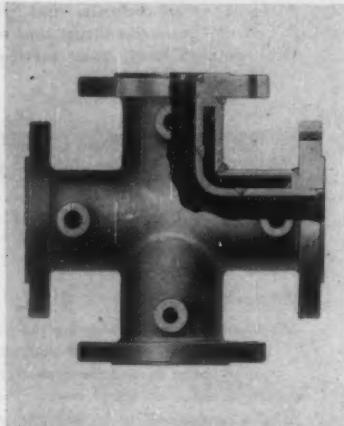
For duty in 4 and 6 in. wells or larger.

Submersible turbine pumps now are available for delivering well water at rates from 600 to 7,000 gph.

Entire unit is corrosion resistant for operation completely submerged in the well water. Pump never needs priming, is water-cooled and water-lubricated.

No running seals are required as the motor is designed to operate in water. Windings are enclosed permanently in a stainless steel case. The durable, waterproof cable is connected with a water-tight fitting.

Motor and turbine pumping unit are completely assembled at the factory, ready for placing in the well.—The Deming Co., Salem, Ohio. 254A



### Jacketed Cross Fitting

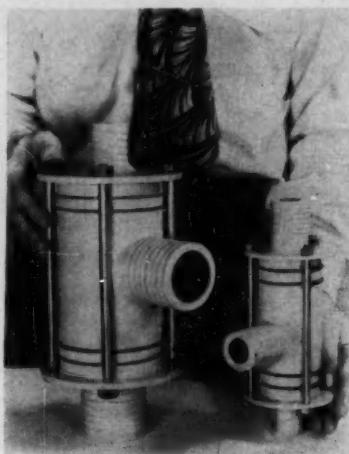
Gives superior performance due to forged construction.

Where flow characteristics are of major importance a new forged steel jacketed cross is said to offer superior heat transfer and corrosion resistance because it is seamless. It is made in forged carbon steel, stainless steel and aluminum.

Cross comes in standard sizes from  $\frac{1}{2}$  to 12 in. for temperatures to 800 F. For larger lines and higher temperature, crosses are custom-made. In addition to standard fittings, crosses are available with

straight sizes on the runs and reducing branch outlets.—Jacketed Piping & Products Co., 503 Columbia Bldg., Pittsburgh 22, Pa.

254B



### Jet Siphons

Constructed of plastic and used for handling waste acid.

These jet siphons fabricated of Furacam plastic reinforced with fibrous glass are used for emptying waste acid from tanks and sumps. Plastic is not attacked by acid or alkaline solutions with the exception of strong chromic or nitric acids. Nozzles are sized for standard acid hose and the unit is easily disassembled for cleaning.

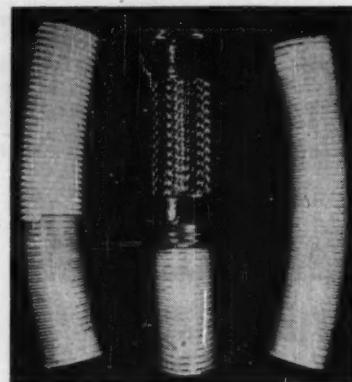
Jets can operate with steam from 10 to 50 psi. The two available sizes have capacities of 1,200 and 4,000 gph, respectively running on 20-psi. steam.—Carl Buck & Associates, Essex Fells, N. J. 254C

because this way there is no corrosion-erosion of the housing even with the highest developed pressures per stage.

High velocity from the impeller is transformed into pressure energy within the diffuser. A volute is used merely as a low velocity collector of the diffuser discharge.

The 16-in. pitch dia. turbine operates at 8,500 rpm. which is sufficient speed for efficient extraction of the available energy in the steam.

Pumps will deliver up to 800 gpm. at discharge pressures to 1,000 psig. and liquid temperatures to 325 F. Turbine is rated for steam pressure to 850 psig. and 850 F.—The J. S. Coffin, Jr., Co., 326 South Dean St., Englewood, N. J. 254D



### Flexible Hose

Fabricated of polyethylene and wire has interesting properties.

Two plies of polyethylene film enclosing a spiral of stainless steel wire are used in a new type of flexible hose. Where additional reinforcement is needed, the hose can be armored with flexible stainless steel braid or heavy plastic outer sleeve.

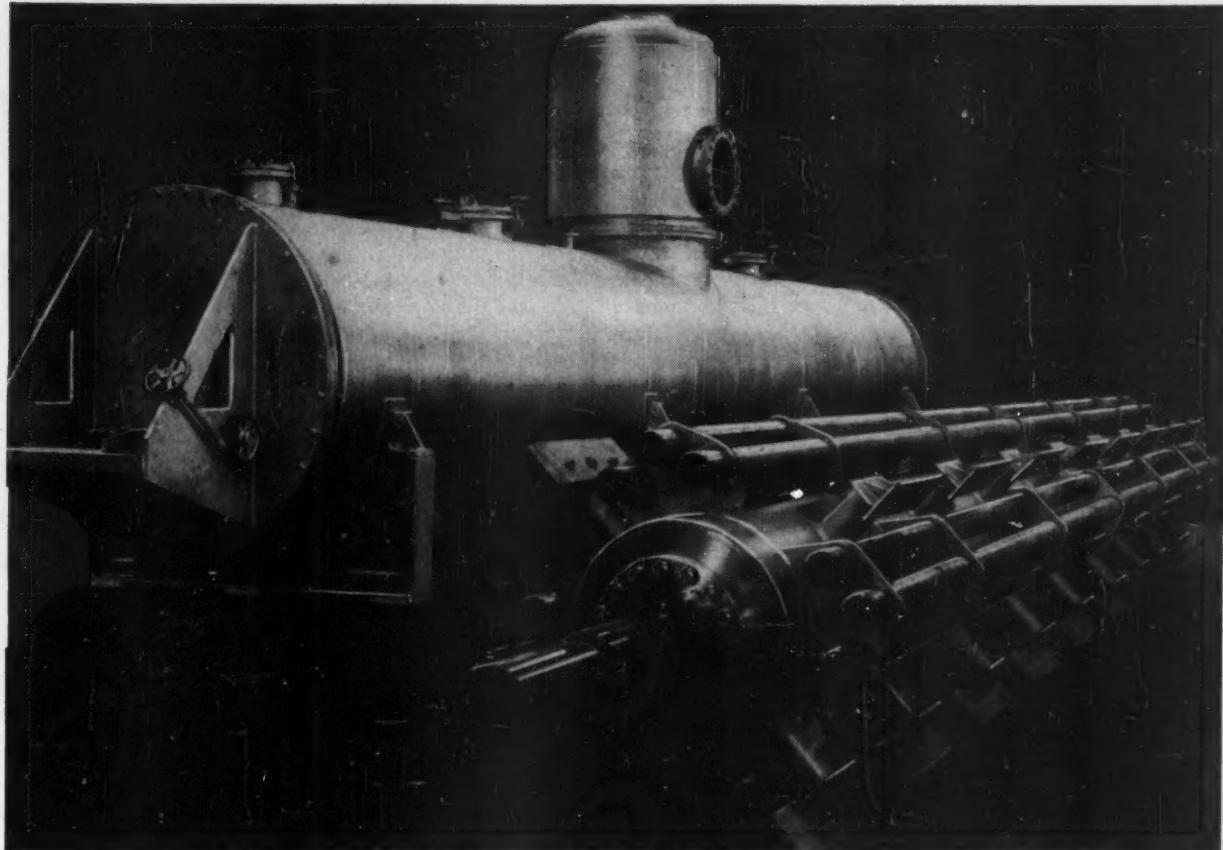
Hose is intended for transfer of a wide variety of chemicals, gases and liquid food products. It combines extreme lightness, flexibility, chemical resistance and durability; retains these properties over a wide range of temperatures.—The Visking Corp., Plastics Div., Terre Haute, Ind. 254E

### Turbo Pump

Designed for high pressure service with long life.

A new turbo-driven centrifugal pump is built for service on boiler feed, evaporator-feed, open heater feed, oil refinery charging, thermal reforming, etc.

Double inlet impeller provides high suction capacity and assures as perfect an axial hydraulic balance as it is possible to achieve. The impeller discharges through a diffuser



*Buflovak Vacuum Rotary Dryer—with revolving heating tubes and heated agitator arms shown separately*

## **Buflovak Vacuum Rotary Dryers provide low temperature drying with agitation . . . and recovery of solvents**

When you need a vacuum rotary dryer, you may readily find that a *Buflovak* conventional type is just right for your production requirements.

Built in a wide range of sizes, this dryer consists of a jacketed cylinder, heated by steam or hot water—charge and discharge openings—and a revolving agitator that accelerates both the drying and the discharging of the dry material. Mounted on the agitator shaft are straight or helical-faced blades, which thoroughly mix the material with a shearing action that reduces power consumption. When desired, other features may be furnished to give these standard *Buflovak* Vacuum Rotary Dryers a wide range of applications.

If your needs require special equipment, our engineers have the practical experience and technical know-how to design and build dryers for any special application. One example is special agitators for breaking up materials that form lumps, thereby reducing them to a uniform powder during drying operation.

In addition, you have the advantages of the complete facilities of the *Buflovak* Research and Testing Laboratory. This includes a pilot test plant which is used for pre-testing both processes and products. It's your assurance that the equipment you buy will meet your requirements.

These services are readily available to help you solve your drying problems.

*Write for Catalog 341 to get complete information about Buflovak Rotary Dryers.*

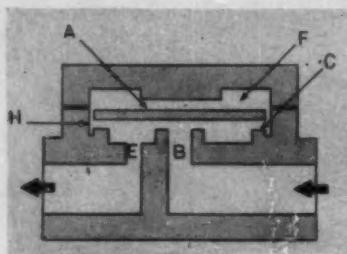
### **BUFLOVAK EQUIPMENT DIVISION BLAW-KNOX COMPANY**

*1551 Fillmore Avenue, Buffalo 11, New York*



**BUFLOVAK PRODUCTS:** evaporators • dryers (atmospheric and vacuum) • solvent recovery and distillation equipment • chemical plant equipment • food processing equipment • kettles • fabricated processing equipment • vulcanizers . . . plus a complete Pilot Plant for pre-testing processes and products.

## NEW HEATING & COOLING EQUIPMENT



### Steam Trap

**Operates thermodynamically to close tight on no load.**

Claiming trouble-free operation a new and different steam trap utilizes the kinetic energy of steam to close the valve. The simple design is free of the usual valve mechanisms, devices, fragile parts and narrow channels.

Trap can vent large volumes of both air and air-steam mixtures. It closes tight on no load and operates against a back pressure up to 50% of its inlet pressure. Condensate is discharged at saturated steam temperature as rapidly as it forms.

A unique valve head consisting of a solid heat-treated stainless-steel disk is the only moving part. The same head and seat are used for pressures to 600 psi. and temperatures to 950 F.

Here is how it works: Disk A forms a valve which seats on inlet tube B and the outer rim C. It is free to rise and fall in chamber F. When seated, the disk A closes the steam inlet tube B and also seals the chamber F from the discharge.

Pressure in the inlet tube B raises the disk allowing air and/or condensate to flow radially across the underside of disk A to the outlet tube E.

When steam follows, the velocity across the disk is much greater and, as the steam strikes the body at H, pressure builds up in chamber F. This causes disk A to seat, closing inlet tube B and sealing steam in chamber F. As pressure in chamber F decreases by condensation, pressure in inlet tube B again raises disk A and the cycle is repeated.—Sarco Co., Inc., Empire State Bldg., New York 1, N. Y. 256A

### Steam Generator

Combines latest advances in packaged unit for low cost steam.

Combined in the type D packaged steam generator are a proven tube arrangement and the most advanced features for production of low cost steam. Generators are performance-rated for high availability and long life at capacities up to 40,000 lb. per hr. continuously.

These generators are completely assembled and fire tested at the factory before shipment. They can be fired economically and efficiently with either gas, a variety of fuel oils or both.

Design features include a rear-mounted forced-draft fan to air cool the furnace roof, tangent-tube waterwall construction and choice of either single or multiple burners.—Superior Combustion Industries, Inc., 1475 Broadway, New York 36, N. Y. 256B



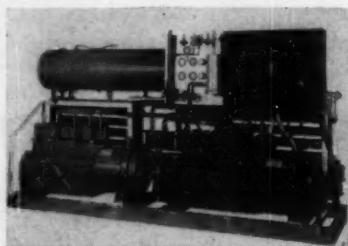
### Drum Dryer

**High capacity pilot unit for granular and crystalline solids.**

A new, compact, rotating-drum dryer can dry up to 3 ton per hr. of granular solids yet needs only 3 x 54 ft. of floor area and 6 ft. head room. Rate of feed and rotational speed can be controlled to satisfy drying requirements.

Dryer operates with either Bunker oil or gas. Feed material enters through a surge hopper located above the drum. Hot gases from inside the drum flow against incoming material in the surge hopper to improve preheating.

Mechanical features include a positive pin-sprocket transmission to the rotating drum and also a pin to pin cam transmission to the turntable feeder disk. This all-positive drive permits manual selection of speed from 8 to 24 rpm. Power for both is one  $\frac{1}{2}$  hp. variable-speed motor.—Roberts & Schaefer Co., 130 North Wells St., Chicago, Ill. 256D



### Liquid Chillers

**Made in wide capacity range, also suitable for gas.**

A new group of liquid or gas chillers reduce temperatures to as low as -130 F. They are being used for condensing CO<sub>2</sub> and for recirculated processing of pharmaceutical, chemical or petroleum products.

Portable models suitable for either laboratory or production use are available in a range of 0.5 to 7.5 hp. Larger remote installations have capacities to 200,000 Btu. per hr. and up to 100 hp. depending on the temperatures needed.

Chillers use a patented cascade system with safe Freon 13 or 22.—Conrad Inc., 183 Jefferson Ave., Holland, Mich. 256C

Mineral-insulated resistance heating element with copper sheath withstands up to 480 F. continuously. It's rugged, resistant to mechanical abuse and corrosives. Wide range of lengths.—Continental Electric Equipment Co., Cincinnati 1, Ohio. 256E

Intermittent make-up of boiler feed water treated with feeder. Compounds added on discharge side of pump. — Cyclotherm Div., U. S. Radiator, Oswego, N. Y. 256F

1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11 ■ 12 ■ 13 ■ 14 ■ 15 ■

### CORROSION RESISTANCE

| MEDIA                          | INDEX | MEDIA                   | INDEX | MEDIA                     | INDEX | MEDIA | INDEX |
|--------------------------------|-------|-------------------------|-------|---------------------------|-------|-------|-------|
| Sulfuric Acid—All Concent.     | 7     | Amine—All Concent.      | 8     | Oleum                     | 8     |       |       |
| Acetone—All Temp.              | 9     | Benzene—160°F           | 9     | Copper—Bolling            | 9     |       |       |
| Acid Nitric Water, -70°F       | 9     | Blood—Cold (Human)      | 9     | Copper Sulfate—Hot, Boll. | 9     |       |       |
| Alcohol—All Temp.              | 8     | Boron                   | 9     | Fruit Juices—Hot          | 7     |       |       |
| Ammeter—All Temp.—All Concent. | 9     | Calcium Hydroxide—Boll. | 9     | Kerosene                  | 7     |       |       |
| Amonium Nitrate—Ext. Boll.     | 7     | Carboxylic Acid         | 9     | Lye                       | 9     |       |       |
|                                |       |                         |       |                           |       |       |       |

302  
316  
430  
**FULLY  
RESISTANT**  
800 INDEX "A"

RESISTANCE TO SCALING

| CONTINUOUS |       |          | INTERMITTENT |          |       |
|------------|-------|----------|--------------|----------|-------|
| TEMP. °F   | INDEX | TEMP. °F | INDEX        | TEMP. °F | INDEX |
| 1200       | 1     | 1800     | 5            | 1400     | 9     |
| 1600       | 2     | 2000     | 6            | 1500     | 10    |
| 1650       | 3     | 2050     | 7            | 1600     | 11    |
| 1700       | 4     | 2100     | 8            | 1650     | 12    |

314

MACHINABILITY

| % OF ALLOY STEEL | INDEX |
|------------------|-------|
| 40               | 6     |
| 50               | 7     |
| 55               | 8     |
| 65               | 9     |
| 85               | 10    |

1430 IS FREE-MACHINING COUNTERPART OF 430  
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The answer to most of your questions about stainless steels are right at your finger tips, when you use Crucible's unique new Stainless Steel Selector.

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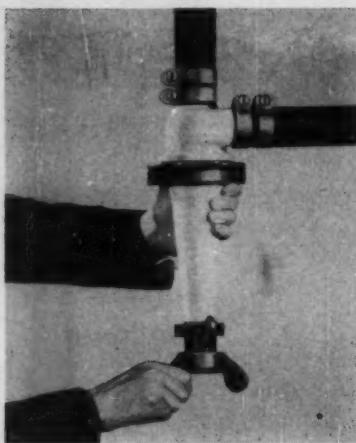
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CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH, PA.

## NEW PROCESSING EQUIPMENT



### Ceramic Cyclone

Resists heat and corrosion on wet classification jobs.

Non-abrasive, relatively fine feed slurries can be separated in the 10 to 20 micron range by the P50 Dorrclone. It is particularly applicable where the feed is hot or corrosive since the 50 mm. dia. cone is constructed entirely of porcelain. To date the unit is successfully classifying clay and calcium carbonate slurries; is handling other jobs in food processing.

Type P50 Dorrclone is 18 in. long and has a 10° cone angle. Maximum operating pressure of 80 psi. produces flow of 30 gpm.; at 5 psi. flow tapers off to 7.5 gpm.

Feed chamber, vortex finder and cone section are all cast integrally in the porcelain body. Each unit is equipped with a steel support ring, rubber-disk apex valve, hose and clamps for the feed and overflow connections.—The Dorr Co., Barry Place, Stamford, Conn. 258A

### Flotation Clarifier

Removes both floatable and settleable solids.

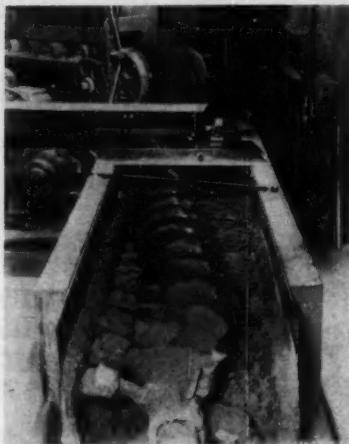
With the Aeroflotor flotation unit both floatable and settleable solids can be removed from water simultaneously. This makes the unit a double-edged weapon for fighting effluent clarification problems.

Influent to the machine is aerated under pressure in the air saturator tank. Upon pressure release, dissolved air comes out of

solution as tiny bubbles. Size of bubbles is variable, depending upon the aeration pressure or pressure drop at the release point and the amount of air in solution.

After entering the machine, the tiny bubbles adhere to suspended particles in the influent floating them to the surface. As the solids float on the surface they dewater partially during removal by skimmer.

Settleable solids falling to the bottom are scraped into the sludge collection pit for removal.—Graver Water Conditioning Co., 216 West 14th St., New York 11, N. Y. 258B



### Solids Mixers

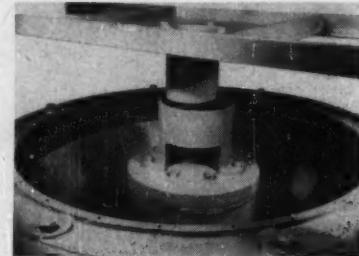
For continuous mixing and pugging of materials ranging from dust to 1½ in. lumps.

Whether dry or in slurry form solids can be mixed or pugged continuously with the new Colonial line of machines. Manufactured in standard sizes the units are engineered with production capacities to suit specific needs. Particular emphasis is laid on helping plants to shift to continuous processing to achieve cost savings.

Specific features include an all-welded frame of heavy steel plate; standard replaceable mixer trough of heavy-gage stock; box-type construction to eliminate dirt catching framework; safety guard over mixing portion of the trough; simplified drive mechanism; and a diversion plate at mixer discharge to eliminate segregation.

Feeding equipment and some other components to make a complete system are available.—The Colonial Iron Works Co., 17643 St. Clair Ave., Cleveland 10, Ohio

258C



### Crusher

Claimed to give greater particle size reduction.

Large tonnages of fine particles can be produced by the Gyradisc crusher using the Gruender reduction method. Actual installation tests on both metallics and non-metallics show substantially greater tonnages of fines than most other methods of crushing.

Crusher alternately impacts and releases a thick mass of material. Feed is intimately mixed so that large particles uniformly distributed throughout the mass prevent packing and assure high output. Mixing and feeding are controlled by the compound action of gyration and rotation of the feed distributor.

An efficient and positive pneumatic release system holds the bowl structure rigidly to the main frame. The mechanism responds quickly to any overload.

Unit is adjusted easily to give desired product size. It's built only in a 54-in. size, can handle feed containing material minus 1, ½ or ¾ in. with or without fines.—Nordberg Mfg. Co., 3075 South Chase Ave., Milwaukee 1, Wis. 258D

### For More Information . . .

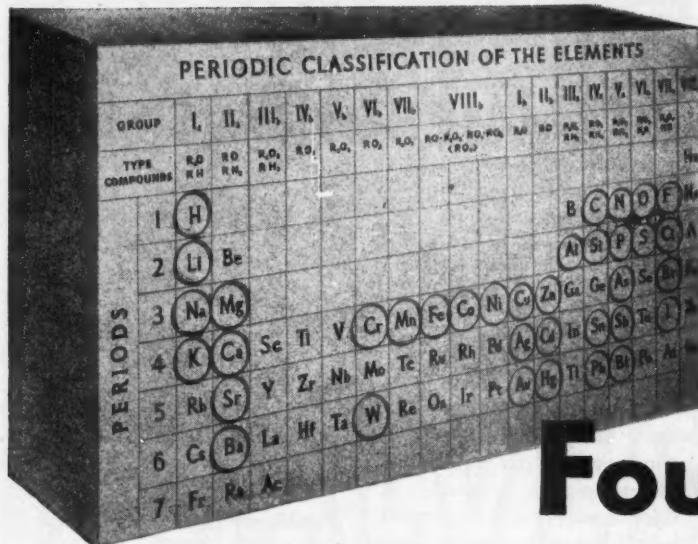


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| Li |    |  |    |    | Al | Si | P  | Cl |
| Na | Mg |  |    |    |    |    |    |    |
| K  | Ca |  | Cr | Mn | Fe | Co | Ni | Cu |
| Sr |    |  |    |    | Zn |    |    | As |
| Ba |    |  |    |    |    | Ag | Cd | Sn |
|    |    |  |    |    |    |    |    | Sb |
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|    |    |  |    |    |    |    |    | Pb |
|    |    |  |    |    |    |    |    | Bi |
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# the Foundation

## Many factors

are involved in the final quality of a product  
in the process industries. The inside story of many difficulties, however,  
is often imperfect starting materials — chemicals, for example.

They are the foundation.

Let something go wrong at the beginning and there is often no cure,  
no way to avoid trouble, expense and rejections. That's why so many concerns  
start with Mallinckrodt chemicals. They're exactly right, always dependable,  
and most chemicals you might need are immediately available.

In case they are not now in stock, in case you need special chemicals  
to meet specific problems — Mallinckrodt will help you in a hurry  
with the right chemical in the right physical form.

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of research and production facilities.

SERVING THE PROCESS INDUSTRIES



Mallinckrodt Chemical Works

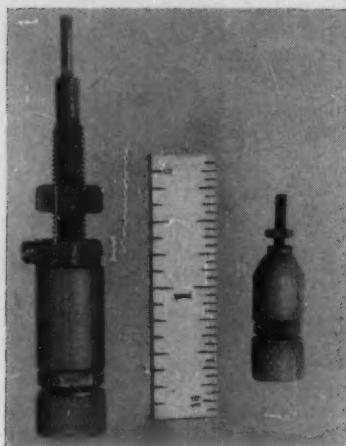
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## NEW INSTRUMENTS & CONTROLS



### Thermocouple

Constructed ruggedly gives extremely fast response.

A new type of thermocouple combines ruggedness with ability to measure rapid temperature changes of metal wall surfaces. It has been tested satisfactorily up to 60,000 psi. under severe mechanical vibration.

A plating of one micron thickness at the junction minimizes the response time of the instrument when temperature changes. Within  $\frac{1}{4}$  microsecond the junction temperature reaches approximately  $\frac{2}{3}$  of the amplitude of a stepchange of the exposed surface.

Two models of the thermocouple have been developed: a small one for use in thin walls and a large one for use in thick walls.—Midwest Research Institute, 4049 Pennsylvania, Kansas City, Mo.

260A

### Controllers

Operating electronically offer process engineer new tool.

Two new instrument lines recently announced are Speedomax type H controllers and series 60 proportional-control units. Both are mounted in the Speedomax case when the equipment is to be used for proportional control. The control unit also is made as a separate instrument for use with L & N Speedomax type G and Micromax controllers.

Type H. Speedomax is made in

single point only, and at present only for measuring temperatures using a thermocouple or resistance thermometer. For on-off control it moves a fuel valve or contactor from fully-on to fully-off, provides dependable null-balance measurement and control in the simplest form.

For proportional control it moves the fuel valve or contactor in proportion to the fuel required through the action of the series 60 control unit.

The series 60 control unit which translates Speedomax measurements into the correct regulating operations is made in three types. These are position-adjusting or duration-adjusting types with proportional, reset and rate actions; and simple proportional control.

Both the Speedomax type H and series 60 control are more compact than predecessor instruments from L & N's line. The series 60 offers greater simplicity, interchangeability of types, plug-in construction plus advances in sensitivity, speed and flexibility demanded today.—Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia 44, Pa.

260B

### Measuring System

Gives remote temperatures and pressures without complex electronics.

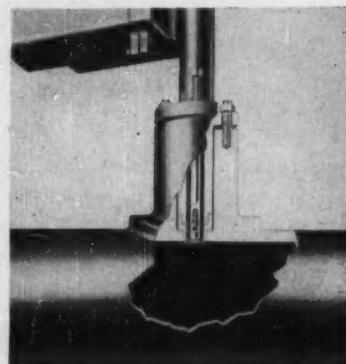
Heart of the new ElectronSyn pressure and temperature measuring system is a signal generator that has been tested and proved in military servo-systems for over a decade. It's explosion-proof, has high output without amplification, is not affected by vibration or line voltage changes and can withstand pressure overload up to 100%.

The signal generator is a high-resolution, electro-magnetic, rotary transducer with a linear output. Fluid pressure in a twisted Bourdon tube or a temperature-sensitive bimetallic ribbon spiral rotates the signal generator a minute amount producing a proportional electrical signal.

A complete system requires a source of constant 60-cycle current,

pressure or temperature detectors mounted directly on vessel or pipeline and an indicating long scale meter mounted on a control panel remotely located from the detection points. Signals can be transmitted over distance using line or microwave facilities.—Controls Division, Control Engineering Corp., 934 Washington St., Norwood, Mass.

260C



### Pressure Transmitter

Produces electrical signal proportional to pressure at high temperature.

A new electrical-output pressure transmitter measures pressure at high temperature, is particularly suited for polymers, asphalts, slurries, molten metals, and viscous fluids that solidify when stagnant. Changes in temperature of the process fluid do not affect the output signal.

The pressure-measuring diaphragm is located inside a well mounted on the pipe line so that the diaphragm surface is flush with the inside of the pipe wall. This way the small-displacement diaphragm can move freely without restricting flow.

Small movements of the diaphragm, in response to pressure changes, are transmitted through a rod to a mechanical linkage. The linkage actuates the core of a differential transformer. Output from the transformer varies from 0.00 to 0.50 v., 60 cycle a.c. and is directly proportional to the pressure being measured.—The Swartwout Co., 18511 Euclid Ave., Cleveland 12, Ohio.

260D

POWELL VALVES...THE COMPLETE QUALITY LINE... POWELL VALVES

... THE COMPLETE QUALITY LINE... POWELL VALVES... THE COMPLETE QUALITY LINE.

# POWELL LUBRICATED PLUG VALVES



FIG. 1559—150-Pound  
Steel Flanged End  
Valve. Sizes 1" to 4".



FIG. 3059G—300-Pound  
Steel Flanged End Valve.  
Sizes 6" to 12".

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Powell Valves—the *complete* quality line—offer many outstanding features in these new Lubricated Plug Valves, such as quick and sure operation and a positive seal when the valve is closed.

Valves are available with screwed or flanged ends; single, screwed and bolted gland types, and in Semi-Steel, Carbon Steel, Bronze, Ni-Resist, Monel Metal, and Stainless Steel. Semi-Steel valves are rated 175 and 200 pounds W.O.G.; Steel valves, 150 and 300 pounds

W.P. Sizes from 1" to 12". Valves in sizes 6" and larger can be furnished with gears for gear operation. Distributors located in principal cities. For descriptive literature—or help on valve problems—write direct to

The Wm. Powell Company,  
Cincinnati 22, Ohio.....109<sup>TH</sup> year

## NEW MATERIALS OF CONSTRUCTION

### Vermiculite Concrete

Shows ability to withstand fire when used in steel roof construction.

Following test by Underwriters' Laboratories a combination roof, with reinforced vermiculite insulating concrete on a ribbed deck, was declared seven times more fire resistive than anything else in its field. During the tests it withstood for one hr. and 49 min. temperatures ranging up to 1,830 F.

Despite the high heat the vermiculite-steel deck did not collapse and deflections were nominal. Under similar conditions an unprotected steel roof deck would be expected to buckle pouring molten pitch or asphalt into the fire.

The test slab had a 1:4 mix of reinforced vermiculite concrete, 3-in. thick, on a Holorib steel deck. Load on the slab was 40 lb. per sq. ft.

Cost of the new system is com-

parable with other unprotected systems.—Vermiculite Institute, 208 South LaSalle St., Chicago 3, Ill. 262A

### Lining System

Ceramic type protects and restores water tanks.

A new ceramic-base tank lining system has the ability to expand or contract with the iron or steel to which it is bonded. It can be used on either new or old tanks.

The 4-in. protective layer will not crack or fail when subjected to variable temperatures from 34 to 230 F. Its effectiveness in preventing corrosion by commercially neutral water is not impaired by extreme temperature fluctuations. There is no tendency for the lining to contaminate the water.—Emjay Maintenance Engineers, 327 Union Ave., Rutherford, N. J. 262B

### Stainless Steel Castings

In extra-low carbon grade now available from West coast foundry.

Stainless-steel castings in the 18-8 and 18-8 Mo grades now can be furnished with a guaranteed maximum carbon content of 0.03, or lower under special conditions. Three years of research have produced practical and economical methods for making this grade of cast steel.

Users of extra-low-carbon stainless steel know that it minimizes corrosion adjacent to welds under severely corrosive conditions. Reduction of carbon from the normal range of 0.08-0.10 to 0.03 is the key factor in controlling carbides. Because of the low carbon content harmful precipitation of carbides is avoided during manufacture or fabrication.—Electric Steel Foundry Co., 2141 N. W. 25th Ave., Portland 10, Ore. 262C



### Reinforced Polyester Resin Plugs Gaps and Strengthens Water Header

This water header at Celanese Corp. of America's Bishop, Tex. plant was little more than an open channel, and worse still, leaking from many holes below the water line. Even the sections still not leaking

were paper thin. But as you can see it was salvaged, thanks to optimism and judicious use of resin laminate. Scale was first knocked off and two plies of glass cloth, saturated with MR-28C self-curing polyester resin,

applied over the large holes. Leaks were then plugged and two additional plies of resin-saturated glass cloth wrapped about pipe.—Celanese Corp. of America, 180 Madison Ave., New York 16, N. Y. 262D

# A WORLD OF EXPERIENCE

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## GRACE CHEMICAL COMPANY

Grace Chemical's \$20,000,000 urea and anhydrous ammonia plant near Memphis, Tenn., is progressing rapidly toward completion. Indications are that production will be available to the industrial and agricultural communities by the beginning of 1955. This means that *NOW* is not too early for users of urea and ammonia to explore this new source of supply. Write for more complete information.

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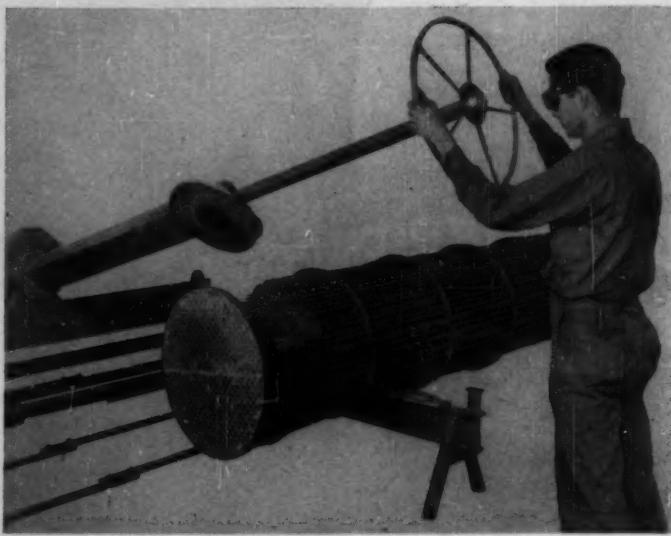
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#### Faster Tube Removal Shortens Retubing Time

With this bundle slicer tube-removal time is cut from 16 or more man hours to 1½. Cutting is done by reinforced, resinoid type, abrasive wheel mounted on long movable arm. Tubes are cut clean without

burn. When wheel is turned over between cuts, the motor reverses rotation, keeping the spark stream away from the operator.—Ohmstede Machine Works, 895 North Main St., Beaumont, Texas. 264A

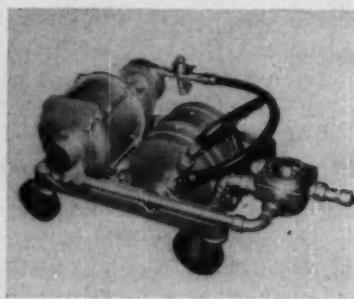
#### Thread Compound

Provides permanent lubricant-seal for all types of threaded fittings.

Containing 90% freshly-disintegrated metallic lead, Big D Dope is claimed to save in excess of 70% on materials and manpower compared with other thread compounds. A single application provides permanent lead-plating permitting repeated, easy, quick assembly and disassembly of any threaded connections without redoping and without damage to the threads.

Compound is warranted anti-gall, non-corrosive, non-hardening and leak-proof. It is resistant to steam, gas, oil, air, chemicals, alkali, acids, ammonia, and all hydrocarbons under the most punishing pressures, temperatures and vacuums. It has been thoroughly proven on hydraulic lines, on nuts

and studs, on all types of pumps and engines, and on large plug valves.—C. H. Dragert Co., Dallas, Tex. 264B



#### Hot Sprayer

Applies sprayable coatings giving better film under field conditions.

Help in controlling corrosion is offered by the Spee-Flo Hot Spray Portable 600 spraying machine. Wherever protective coatings are

applied outdoors it saves up to 35% of labor, gives better quality by spraying hot.

Vinyls, enamel, cutback asphaltums and similar materials can be sprayed hot to give a smoother, denser, less porous film that is free of pinholes and imperfections. Application is faster and film thicker.

Unit has a heavy-duty, 2,000-w., UL-approved heater and explosion-proof motor. Delivery rate is 15 gph. at distances up to 50 ft. from the heater.—Spee-Flo Corp., Houston, Tex. 264C

#### Improved Arc Welding

Increases welding speed 15 to 20 percent, lowers cost 25 to 50 percent.

Higher welding speeds, better quality welds and lower operating costs are the principal benefits of a new consumable-electrode, inert-gas arc-welding process. While the consumable electrode process has been used for several years to weld stainless steel this new system now allows the welding of mild steel.

Welds made by this system can be painted without cleaning as there is virtually no spraying or spatter of electrode material, nor is there any slag-covering on the weld. Appearance is improved so that externally the weld looks to be part of the design while internally penetration is exceptionally good and of sound x-ray quality.

Most significant advance in the new system is the electrode wire. It's a special analysis mild steel with a coating that stabilizes the arc, eliminates spatter and assures good penetration with high burn-off rate.—Westinghouse Electric Corp., 401 Liberty Ave., Pittsburgh 30, Pa. 264D

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number on the  
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Postcard inside the back cover.



# News about COATINGS for METALS

Metallic ..... Organic ..... Decorative ..... Protective

## New corrosion-control "tool" provided by spraying-type plastisol

### Ucilon Protective Coatings solve many problems

A variety of Ucilon\* Protective Coating Systems, using either air-drying or baking coatings are available to handle problems that cannot be solved with plastiols. Applied like ordinary paint, Ucilon Coating Systems resist the same corrosives as plastiols and even some that plastiols do not withstand. The line includes systems based on vinyl, phenolic, chlorinated rubber and other chemical resisting coatings. Detailed information is provided in Bulletin MC-8. Send for it - no obligation.

\*Trade Mark

### Four types of drum linings handle most needs

Protection against drum corrosion and contamination of product is being obtained by many major steel drum suppliers by four basic types of Unichrome Drum Linings.

These include: (1) Phenolic base linings which are well suited for packaging solvents, oils, acid products and are used extensively in shipping detergents. (2) An epoxy resin base lining that not only gives essentially the same chemical resistance as the phenolics but also better flexibility and alkali resistance. (3) Vinyl base linings which are used effectively for packaging foods as well as caustics, latex, potable mineral oils and the like. (4) Plastisol drum linings which resist a wide range of products and are good for multiple trips.

Bulletin DL-2 gives you more details.

#### UNITED CHROMIUM, INCORPORATED

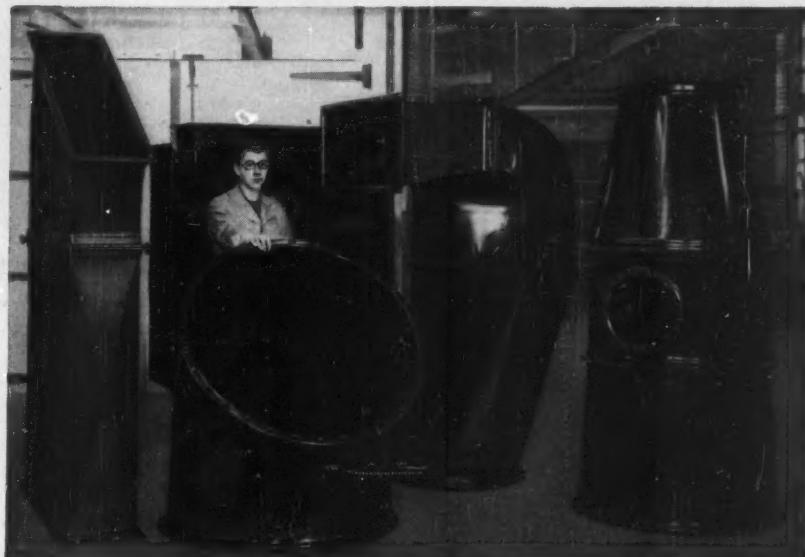
100 East 42nd Street, New York 17, N. Y.  
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In Canada:

United Chromium Limited, Toronto 1, Ont.

*Unichrome Series 5300 Plastiols protect equipment with single coats up to 25 mils thick*



These fume control ducts, better equipped to resist corrosion, typify the large areas which can now be protected with Unichrome Plastiols.

ANY metal surface that can be sprayed and uniformly baked can now be protected against severe corrosive conditions with vinyl plastiols. Development of Unichrome Series 5300 Plastiols, the first practical sprayable plastiols, offers engineers the solution to many chemical corrosion problems.

#### UNUSUAL PROTECTION

Unichrome Series 5300 Plastiols have many advantages over ordinary coatings. They offer continuous, seam-and pore-free protection against a wide variety of corrosives, including acids, alkalies, water, salt solutions, oxidants, reducing agents, and many others. They level surface irregularities and provide substantially greater protective film thicknesses.

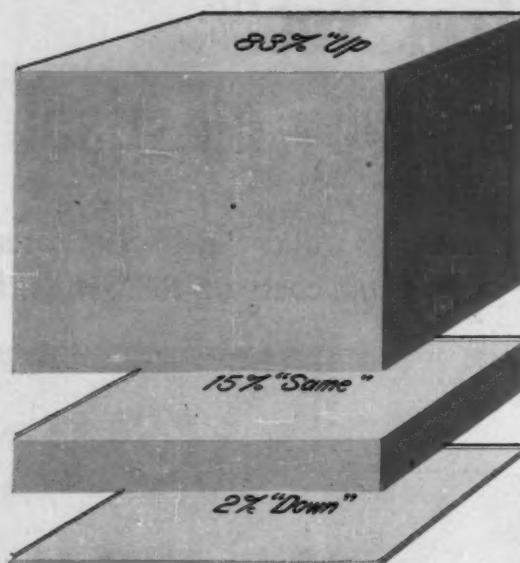
ness, features particularly important in coating surfaces that are not smooth. 5300 Plastiols are resilient, resist abrasion, chipping and cracking. Single coat dry film thicknesses up to 25 mils can be obtained.

#### ASSISTANCE IN SOLVING PROBLEMS

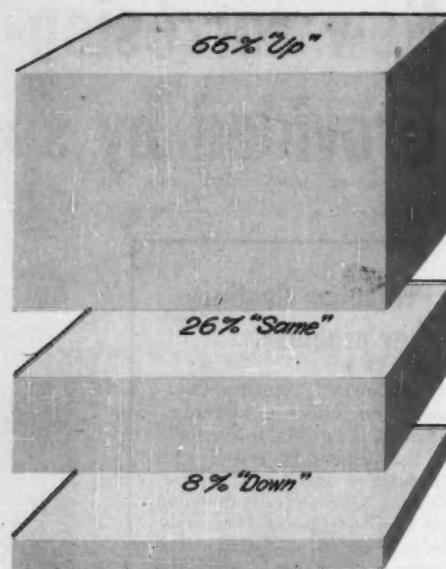
United Chromium, with its unequalled experience in the plastiols field, provides detailed recommendations on solving corrosion problems with plastiols. Interested engineers need only provide details of their problems. The company can also provide the names of coating specialists qualified to apply plastiols to your equipment.

More information about Unichrome Series 5300 Plastiols may be obtained by sending for Bulletin VP-1.

## What Manufacturers Say Their Sales Will Do in 1955



Chemical Process Industries



All Manufacturing

## Why 1955 Will Be Chemicals' Best Year

**Chemical production, like sales will set new records this year. And capital spending, though expected to dip slightly, will stay at an extremely high level.**

William H. Chartener, McGraw-Hill Dept. of Economics

For the chemical industry, 1955 will be the year when long-run growth reasserts itself and carries production and sales to new peaks. For other manufacturing industries—and for the economy as a whole—1955 promises to be somewhat better but not up to the boom levels of 1953.

► **Sales Lead the Way**—The chemical sales outlook, as determined by a recent McGraw-Hill survey, is almost uniformly bright.

Only 2% of the chemical process companies reporting expect their sales to drop in 1955; all of these

are in the chemical industry proper. Not one of the companies reporting in the related paper, rubber, or stone, clay and glass industries expect lower sales. And the same happy situation prevails in the petroleum industry.

Higher sales are expected this year by 83% of chemical process companies and by 78% of petroleum companies reporting. Firms expecting sales to be just about the same as in 1954 amounted to 15% in chemical processing, 22% in petroleum.

In all manufacturing, only 66%

of the companies reporting predict their sales will rise. About 8% expect a drop and the remaining 26% expect sales to be just about the same.

► **Up From a Slump**—Sales of chemicals and allied products rebounded quickly after a slow first quarter in 1954. Second quarter sales matched those of the same period in 1953, running about \$5.1 billion.

This rise in sales should continue in 1955 at a healthy rate and put total sales for the year more than 5% over 1954. The late surge in 1954, in fact, may put both production and sales figures over 1953 when final statistics are available.

► **Spending: Down But Still High**—Chemical processing firms are backing their confidence in rising sales

# Welding Copper



Inert gas shielded metal arc welding of new copper shell for rebuilt tower.

## SAVES 38% in materials and labor for joining

Some time ago, the Tennessee Eastman Company, Kingsport, Tennessee, a Revere customer, began to rebuild some of its copper stills or fractionating towers, which previously would have been silver-brazed. Revere's welding specialists were called in to see whether or not welding would be superior. Demonstrations were made to Tennessee Eastman engineers and shop personnel, with the result that welding was adopted. Actual experience in the shop shows a saving of 38% in materials and labor for joining, and a better job in every way. The welding method used is the inert gas shielded metal arc process.

Reconstruction of the towers was made to reduce the number of flanges. At the same time Tennessee Eastman changed from the flange joint tray construction to the inserted tray type and incidentally, reduced the number of gaskets with their accompanying maintenance problems. The trays are salvaged by shearing off the bolt hole circle and folding up the edges. The towers are some 45' high, 6' to 10' in diameter, with a tray or bubble cap plate at

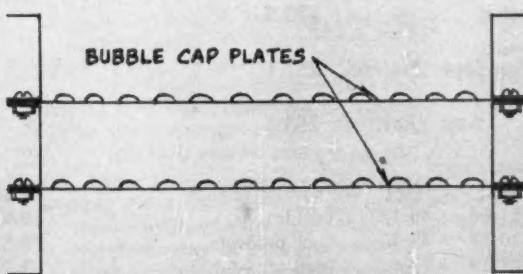
specified intervals. Tennessee Eastman plans to rebuild several towers a year in this economical way.

It will pay you as it did Tennessee Eastman to look into welding as a modern method of joining copper. Remember Revere is fully experienced in the most modern and efficient methods, and will collaborate with you on their application.

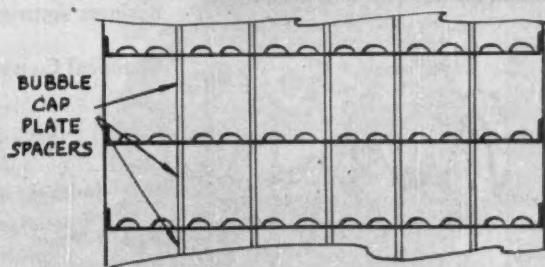
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Section through old tower, showing bubble cap plates held in bolted flange.



Section through new welded tower. Bubble cap plates have had bolt holes sheared off, edges turned up. They are held in place by spacer rods.

## ECONOMICS . . .

during 1955 and later years by maintaining a continuing high rate of investment in new plants and equipment.

Preliminary plans reported to McGraw-Hill indicate a drop of only 2% in capital spending in the year ahead by the chemical processing group—including refining and petrochemical facilities. For all manufacturing, the expected capital spending decline is 7%. And for all industry the indicated drop is 5%.

Of the individual process industries, the chemical industry proper accounts for the biggest projected capital outlay—\$1.3 billion out of a total of \$2.9 billion. Petroleum refining, with plans to spend \$717 million, leads the related processing industries. The ceramic group (glass, clay and stone) boasts the only increase, but it's an impressive 23%.

The chemical process group as a whole will account for more than a third of all capital spending in manufacturing in 1955, replacing metalworking as the largest single group.

**► Spending in 1956: Leveling High**—An advance look at capital spending plans for 1956 shows a leveling off of investment at a high rate, despite the virtual end of the defense expansion program.

Nearly half—46%—of the companies in chemical processing expect to invest about the same in new plants and equipment during 1956 as in 1955; 29% expect to spend more. In chemicals proper, 37% of the firms plan to boost spending in 1956. Only in the rub-

## Capital Spending by Chemical Process Industries

|   | Millions of Dollars |                   |                 |                       |
|---|---------------------|-------------------|-----------------|-----------------------|
|   | 1953<br>Actual      | 1954<br>Estimated | 1955<br>Planned | % Change<br>1954-1955 |
| Chemicals . . . . .                     | \$1,559             | \$1,328           | \$1,969         | - 4%                  |
| Petroleum refining . . . . .            | 675                 | 767               | 717             | - 7                   |
| Pulp and paper . . . . .                | 431                 | 448               | 423             | - 6                   |
| Ceramics (glass, stone, clay) . . . . . | 339                 | 335               | 413             | +23                   |
| Rubber . . . . .                        | 158                 | 133               | 121             | - 9                   |
| Total . . . . .                         | \$3,162             | \$3,011           | \$2,943         | - 2%                  |
| Percent of all manufacturing . . . . .  | 32%                 | 33%               | 34%             |                       |

Source: U. S. Dept. of Commerce, Chase National Bank, McGraw-Hill Dept. of Economics

ber industry do a majority of companies—55%—expect their capital spending to drop in 1956.

**► And It Could Be More**—Past McGraw-Hill surveys have shown that most companies underestimate their investment plans for more than a year in advance. So 1956 may be a year of even greater capital spending than 1954 for the chemical process industries. Plans for 1955 spending might also be increased during the year if overall business recovers sufficiently.

**► Output Will Be Up, Too**—The recession which began about 18 months ago didn't have a severe impact on the chemical industry. Chemical production, as measured by the Federal Reserve Board Index (seasonally adjusted), dipped only 6% between July 1953 and January 1954. There was a steady rise all through last year and the previous peak was topped early last fall.

Industrial production as a whole, on the other hand, dropped 10% from July 1953 to March 1954 and

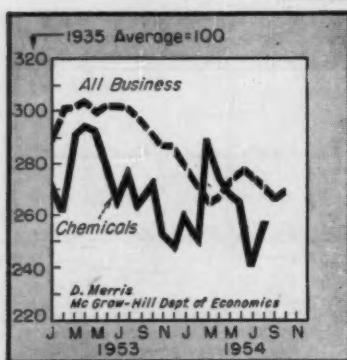
rose only slightly above the bottom figure of 123 (1947-1949 = 100) during the latter part of last year.

Output in the broader group of chemical process industries, which totaled about \$56 billion in 1954, should surpass the 1953 record of \$59 billion this year. This will mark the resumption of the growth trends which are expected to boost annual production in chemical processing industries to some \$70 billion by 1960.

**► What's Behind the Boom**—The glowing outlook for chemicals in 1955 comes not only from the reassertion of long-run growth trends, but from an improved economic picture generally.

Gross National Product—the sum total of goods and services produced during the year—will probably rise about \$8 billion over the \$356 billion at which the economy held steady through most of last year. This would be nearly identical with the record \$364.9 billion reached in 1953, though still below the peak annual rate of \$370 bil-

## CONSUMPTION INDEX



Business Activity (Oct.) . . . . . 270.5

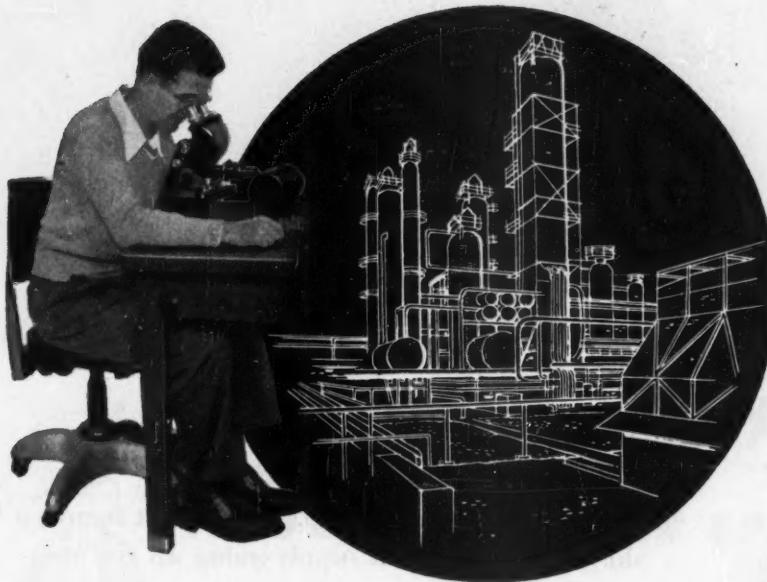
Chemical Consumption Sept. (Prelim.) . . . . . 257.1

Aug. (Rev.) . . . . . 254.4

| Indexes                | Sept. | Oct.  |                                 |
|------------------------|-------|-------|---------------------------------|
| Fertilizer . . . . .   | 51.05 | 48.17 | Paint & varnish . . . . . 27.68 |
| Pulp & Paper . . . . . | 30.77 | 32.52 | Textiles . . . . . 9.96         |
| Petroleum ref. . . . . | 27.24 | 27.66 | Coal products . . . . . 9.57    |
| Iron & steel . . . . . | 12.49 | 12.23 | Leather . . . . . 3.98          |
| Rayon . . . . .        | 26.06 | 27.13 | Explosives . . . . . 8.12       |
| Glass . . . . .        | 22.58 | 25.37 | Rubber . . . . . 4.52           |
|                        |       |       | Plastics . . . . . 17.52        |



## **is corrosion costing you too much?**



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**T**HREE are over twenty-five basic grades of stainless steel tubing, variations of which add up to many more analyses which can be employed in solving your corrosion problems.

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## ECONOMICS . . .

lion attained in the second quarter of 1953.

► Who Does the Spending—Government purchases of goods and services should show little over-all change. Though federal spending will likely drop \$1.5 to \$2 billion, this will be offset by an almost equal rise in state and local government spending.

Private investment should increase by about \$2 billion, largely because of the end of the inventory run-off that characterized 1954. Increases in inventory count as investment in Gross National Product and decreases in inventory are subtracted from investment.

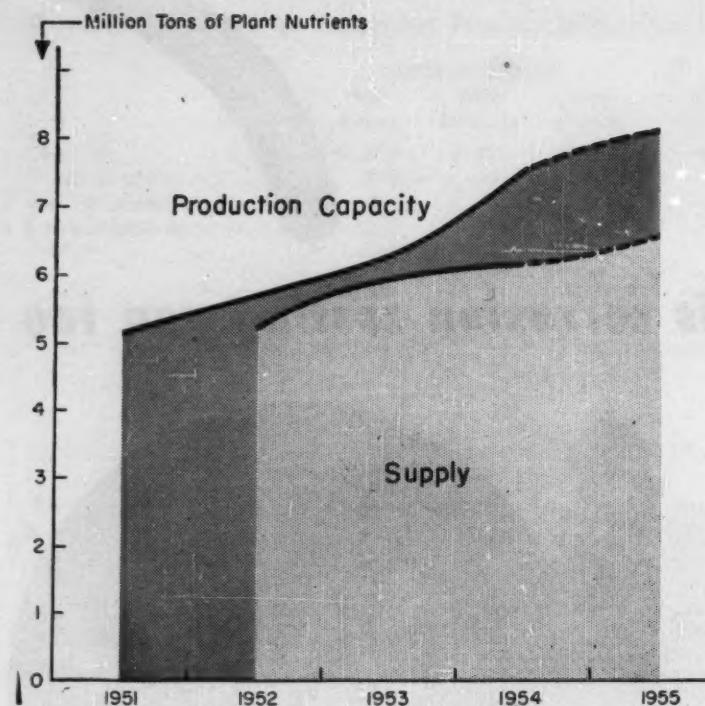
Producers' durable equipment expenditures will probably decline about \$1 billion. But new private construction—sustained by booms in housing and commercial buildings—should remain near present levels.

Consumer expenditures, which took up much of the slack caused by drops in government spending and private investment in 1954, will continue their rise in 1955. Auto makers expect a good year with bright new models, which should hold consumer expenditures on durables at \$28 billion. Spending on nondurables will follow the population increase and rise about \$4 billion.

Finally, spending on services, which seems to be enjoying a long-run rising trend should go up another \$2 billion in 1955.

► Others Should Gain—Most of the industries that are important customers of the chemical industry stand to do better in 1955 than they did last year. The over-all Federal Reserve Index of Industrial Production should be about 128—up 3%. Individual industries using large amounts of chemicals that should show improvement include textiles, rubber, paper and food processing.

In short, the chemical industry had to rely on underlying growth trends to hold production and sales to a small drop in 1954. Now, with recovery evident in business generally, these growth forces can once again carry the chemical industry to new records.



## Fertilizers: Piling Up?

**Some say yes, some say no. But recent figures show production and supply going up and up.**

No matter how you slice it, the emphasis is on more and more fertilizers these days. More capacity, more production, more consumption. A recent USDA prediction is that there'll be a total 1954-1955 supply of primary plant nutrients 5% greater than the '53-'54 total.

Here's the breakdown:

| Nutrient        | '53-'54 | '54-'55 |
|-----------------|---------|---------|
| Nitrogen.....   | 2.020   | 2.200   |
| Phosphates..... | 2.364   | 2.350   |
| Potash.....     | 1.831   | 1.970   |

For comparison, here are the 1952-1953 supply figures:

|                 |       |
|-----------------|-------|
| Nitrogen.....   | 1.804 |
| Phosphates..... | 2.414 |
| Potash.....     | 1.739 |

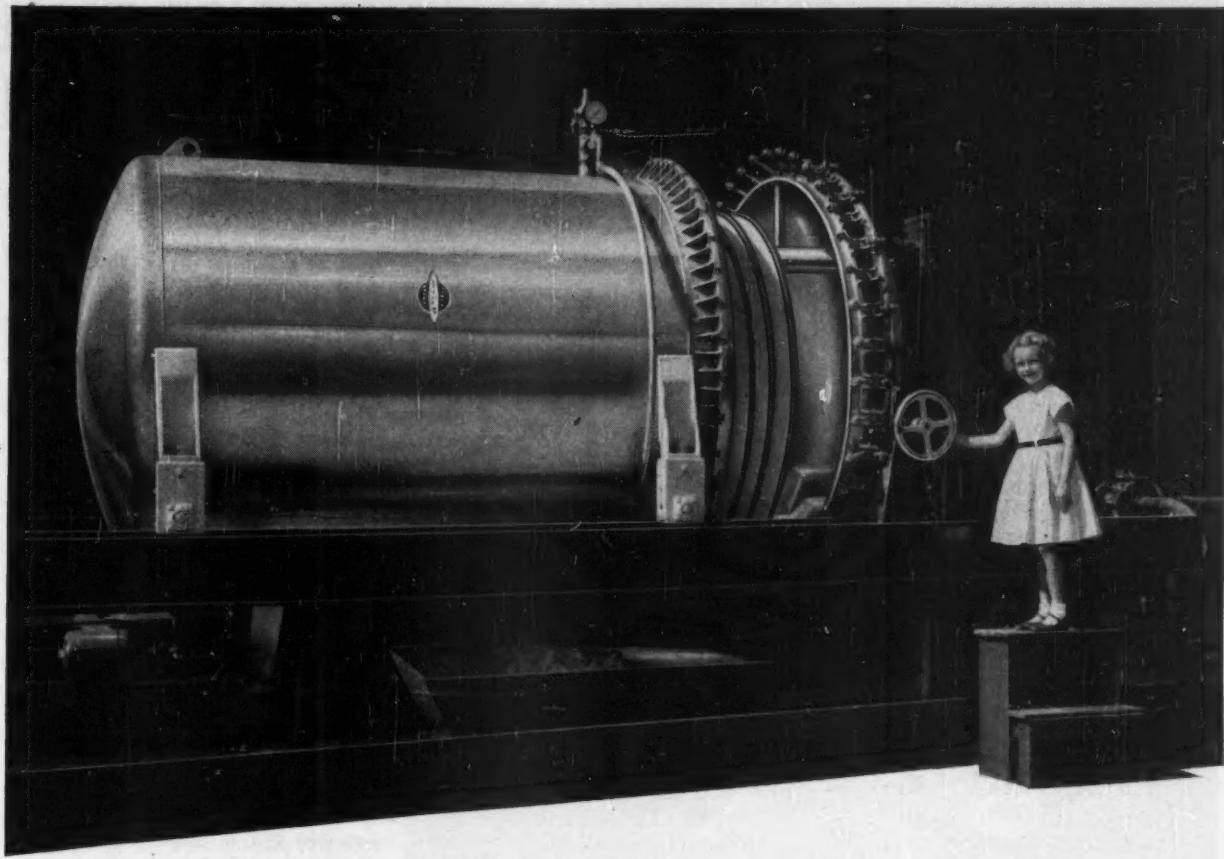
► Misleading Figures—Total U.S. consumption of all kinds of fer-

tilizers can be misleading, however. In 1953-54, 20,290,549 tons were consumed, a 1.5% drop from the 1952-53 figure of 20,603,448 tons.

But tucked away in these statistics is an important trend taking shape—the trend toward production of more concentrated plant foods. Very probably consumption of active ingredients was up in the '53-'54 crop year, but these ingredients were in more concentrated form.

For example, take anhydrous ammonia for direct application. Having its start in 1943, this technique has been enjoying steady growth. In 1952-53 about 12% of all nitrogen supply was in the form of anhydrous ammonia. In 1953-54 it was at 17%. And in '54-'55 it's expected to go up to 18%.

► Plenty of Expansion Plans—By



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**...to open up the MCR SPARKLER FILTER**

The most effortless operated filter made. Talk about economy in operation; the labor and time saved alone in opening, cleaning and closing the MCR gives a running start in cost saving that puts you out ahead of manual operated filters. There is no labor problem with the MCR; operators love this filter.

Whether you are filtering heavy chemicals, pri-

mary filtration of beer, heavy oils, or any product with a high bulk residue you will find this power operated aristocrat of heavy duty filters faster, easier, and more efficient at every step in the filtering operation.

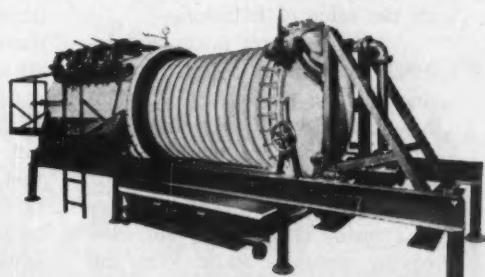
No breaking of pipe connections—self sealing cover gasket—complete drainage—smooth power retraction of the tank—are advanced, operating features that put this new filter in a class by itself.

Write Mr. Eric Anderson for engineering details of this filter as applied to your particular filtering problem.

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is available in capacities up to 2000  
sq. ft. of filtering surface.



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## ECONOMICS . . .

1975 the American farmer is going to have to feed at least 200 million hungry Americans. This is a challenge and an opportunity for the fertilizer industry. And latest government information seems to bear out the fact that the industry has really taken up this challenge—with gusto.

Last year the Office of Defense Mobilization set up a 1957 domestic nitrogen production goal of 3.5 million tons a year. In 1951 we had a total capacity of 1.4 million tons; in July 1954 we had a capacity of 2.9 million tons. Now it looks like the goal will definitely be met—and perhaps exceeded.

For phosphates, production fell a little short of the goals, although capacity increases have been impressive—up from 2.2 million tons in 1951 to 3.3 million tons in 1954-55. The same story holds for potash output, which will have risen from 1.4 million tons in 1951 to the production goal of more than 2 million tons in 1954-55.

► No Bed of Roses — There are plenty of people who look at the fertilizer picture and slowly shake their heads. Fertilizer supply is going up, they say, but will the farmers use it all? Apparently not, according to this group, for they believe the expansion is artificial, propped up by war and inflation.

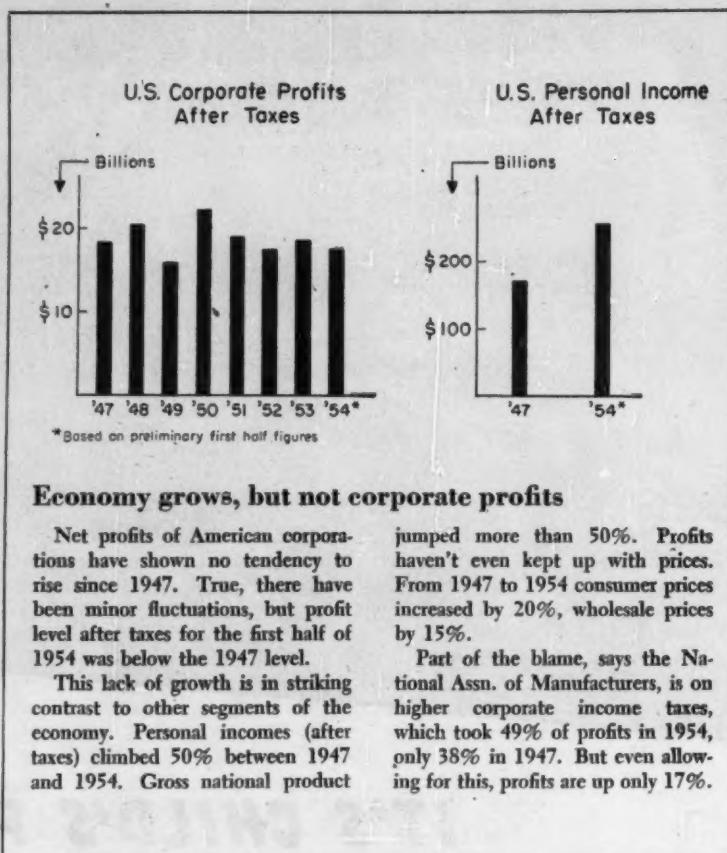
There's no doubt that expansion has been rapid, particularly in nitrogen fertilizers. But the experts say the farmers will use all the fertilizer produced.

Here are a few of the many reasons behind this optimistic thinking:

- Industry and government are going all out to sell the farmer on the value of fertilizers.

- Falling farm prices will increase the farmers' interest in producing more per acre to maintain his income level. Government acreage restrictions are already having this result.

- Our population is increasing at a steady rate, a sure indication of the need for more food—and more fertilizers since our tillable land not already in use is very small.



### Economy grows, but not corporate profits

Net profits of American corporations have shown no tendency to rise since 1947. True, there have been minor fluctuations, but profit level after taxes for the first half of 1954 was below the 1947 level.

This lack of growth is in striking contrast to other segments of the economy. Personal incomes (after taxes) climbed 50% between 1947 and 1954. Gross national product

jumped more than 50%. Profits haven't even kept up with prices. From 1947 to 1954 consumer prices increased by 20%, wholesale prices by 15%.

Part of the blame, says the National Assn. of Manufacturers, is on higher corporate income taxes, which took 49% of profits in 1954, only 38% in 1947. But even allowing for this, profits are up only 17%.

### Soviet Chemical Output Still Far Behind U. S.

In chemicals and petroleum, the USSR has no excess production and cannot outproduce the United States in the foreseeable future. Nevertheless, an over-all increase in output and improved Russian technology are anticipated.

These statements by J. G. Tolpin (Std. Oil, Ind.) keynoted a comprehensive analysis of Russia's chemical and oil industries presented recently to the National Industrial Conference Board. Here are some of Mr. Tolpin's supporting facts.

► **Chemicals**—U. S. chemical output is estimated to be four times that of Russia. Though there are no USSR surpluses, records do show some exporting of fertilizers, pharmaceuticals and chemicals.

Sulfuric acid production in Russia is about one-fourth that of the U. S. We produced 2.5-2.9 times

as much nitrogen. In soda ash the ratio is probably 4 or 5 to 1; in calcium carbide, 2-4:1; in superphosphate, 4:1; in rayon—Russia's only commercial synthetic fiber—5:1; in synthetic rubber, 1.5-2:1. ► **Petroleum**—For every barrel of oil produced in Russia, the U. S. produces 6.8 barrels. Counting imports the lead may be 8 to 1.

In 1953, Soviet oil production totaled slightly over 8% of world production. The entire Soviet bloc accounted for 10% of the world's oil output. By 1955 Russia aims to be producing 500-550 million barrels. But this goal, which would require a higher annual increase than attained in the last few years, may still fail to give Russia a much larger share than she now has.

Soviet refining capacity is about 90% of its production, with a cracking capacity of 300,000 bpd. in 1951. U. S. capacity is 8-10 times greater. Equally important, many of Russia's fifty-odd refineries

# HOW TO BUY RUBBER HOSE

## FOR EASY HANDLING ON TOUGH JOBS . . .

and get "More Use per Dollar"

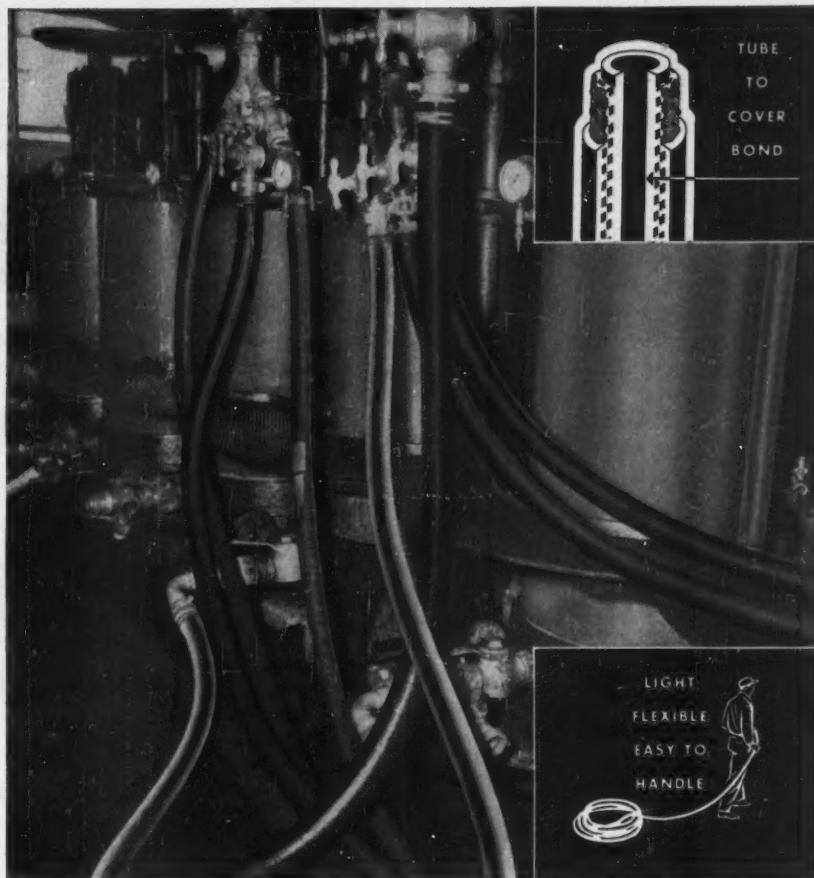
Select a light weight hose construction that is flexible and kink resistant for long-life dependability.

Hose that is light in weight—yet strong enough to safely withstand high pressures—is easier to handle. Men like it better and do more work with it. Look for a hose that is light, yet strong, for ease of handling.

If the hose you buy resists kinking you are assured maximum flow under all operating conditions. Hose that is mandrel-made, rather than molded in a pre-set coil, will coil and uncoil freely in any direction . . . eliminate points of strain at kinking points that can cause costly internal damage and rupture.

Make certain the hose is engineered for maximum flexibility . . . from tube to cover. Tube-to-cover flexibility prevents separation of cover, tube or strength member plies . . . reduces hose costs by increasing hose life.

Specify the one hose that gives you all these features . . . specify R/M Homoflex Hose.



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The unique construction of Homoflex Hose makes it easier to handle because it is light, has no pre-set twist . . . coils and uncoils easily without kinking. All unneeded bulk has been engineered out. An exclusive process creates a homogeneous cover, strength member and tube that are virtually inseparable to produce a hose construction that is extremely flexible, yet rugged

and strong. Homoflex Hose does a better job under tough conditions . . . and it lasts longer. Inside and outside diameters are uniform.

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Asbestos Textiles • Packings • Engineered Plastic, and Sintered Metal Products • Bowling Balls

are old and need much repair.

On the other side of the ledger, the U. S.-USSR oil production ratio, which was 12:1 in 1945, has been dropping consistently. During 1951 refining capacity jumped 125,000 bpd. And the current five-year plan, to be completed in 1955, calls for an 85% boost in oil production, while refining capacity is being doubled, cracking capacity increased 170% and construction of equipment for the oil industry expanded 250%.

► **Data Sources**—Calculating Russian production of anything is at best a tedious job, based mostly on government reports which are often simply rehashes of old releases, but which might have some grains of fact.

For instance, Russia's Ministry of the Chemical Industry reported recently that its production quota for the first half of 1954 was topped by 3%. Output gains cited over the like 1953 period were: caustic soda, 11%; soda ash, 12%; min-

eral fertilizers, 11%; agricultural poisons, 31%; synthetic dyes, 2%; synthetic rubber, 1%. Production of chemical equipment is said to have risen 15%.

As usual, no actual production figures were given. But it is known that all increases, except for fertilizers, were smaller than those claimed for the full year 1953 over 1952. Working back from such data, it's sometimes possible to calculate approximate output of some products.

## GUIDED TOUR C O N T I N U E D

### PICTURED FLOWSHEET

**Semi-chemical pulp, continuously and fast... 300**

### NAMES IN THE NEWS

**Roger Williams: Perkin Medallist..... 307**

**Names that made news last month..... 308**

### PRO & CON

**Letters to the editors..... 314**

### TECHNICAL BOOKSHELF

**Newcomers for your reference shelves..... 320**

**Recent books & pamphlets..... 324**

### FIRMS IN THE NEWS

**Who's doing what among your suppliers..... 326**

### TECHNICAL LITERATURE

**Manufacturers' new literature..... Reader Service**

### Continuous digestion . . .

. . . features American Box Board's new pulp mill where it is only one hour from chips to paper. (p. 300)

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Inside Back Cover

# HERE'S REAL MATERIAL HANDLING NEWS

## New STEARNS 2-coil magnetic pulley removes more tramp iron than larger units on many conveyor operations—yours may be one

Stearns now offers a powerful new electromagnetic pulley that provides exceptional tramp iron removal *throughout the entire load mass*. Two-coil design produces a magnetic field that is deepest at the center of the conveyor belt where load is heaviest. The area of magnetic attraction is the same general shape as the load on a conveyor operating under standard conveyor practices.

### Pulley costs less

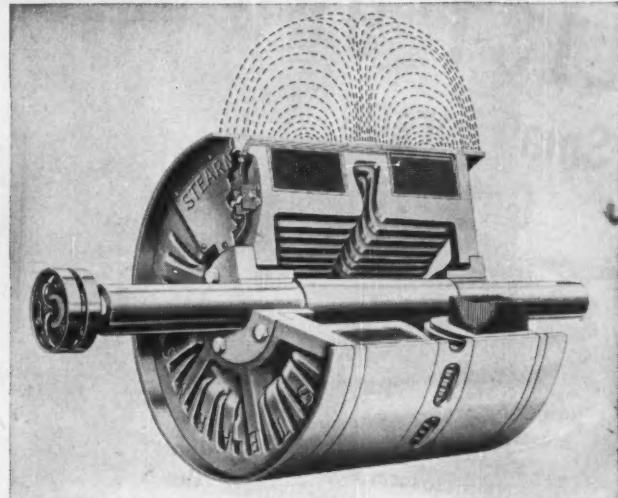
Because of the nature of the magnetic field, smaller pulleys costing less, can now be used on jobs where larger units were formerly needed. An examination of data on a number of proposed installations showed that, in the majority of the cases, the recommended new 2-coil pulley is of smaller diameter than a 3-coil pulley handling the same job.

Get all the facts on this new magnetic pulley. Find out how it simplifies pulley selection. Write for bulletin 303-C.

### SIMPLIFIED PULLEY SELECTION METHOD\*

Because this pulley fits right into recommended conveyor standards for speed of belt travel and depth of load for various types of materials, it is far simpler to select the right pulley than ever before. Stearns provides new selection tables in Bulletin 303-C that now make it possible for you to select the right size unit for your job even before you consult our sales engineers.

\*Copyrighted 1954 Stearns Magnetic, Inc.



Cutaway showing 2-coil construction. This design provides a deeper magnet field at the center of the pulley — a pattern which conforms to normal load conditions.

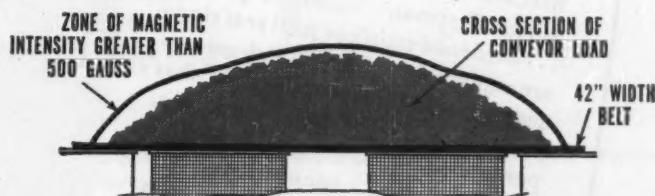


Diagram showing magnetic field for 2-coil, 36-in. dia., 42-in. wide pulley. Note how magnetic field blankets entire load.

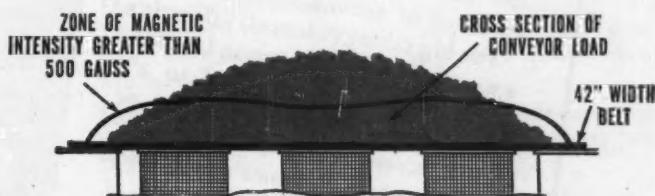


Diagram of same size 3-coil pulley. Note center of load extends above magnetic field. Conveyor would require a larger pulley operating at slower speed in order to do an effective tramp iron removal job.

1106

### MAGNETIC EQUIPMENT FOR ALL INDUSTRY

# STEARNS MAGNETS

STEARNS MAGNETIC, INC., 629 S. 28th St., Milwaukee 46, Wis.



# OPEN AND SHUT CASE FOR CHAPMAN LIST 960

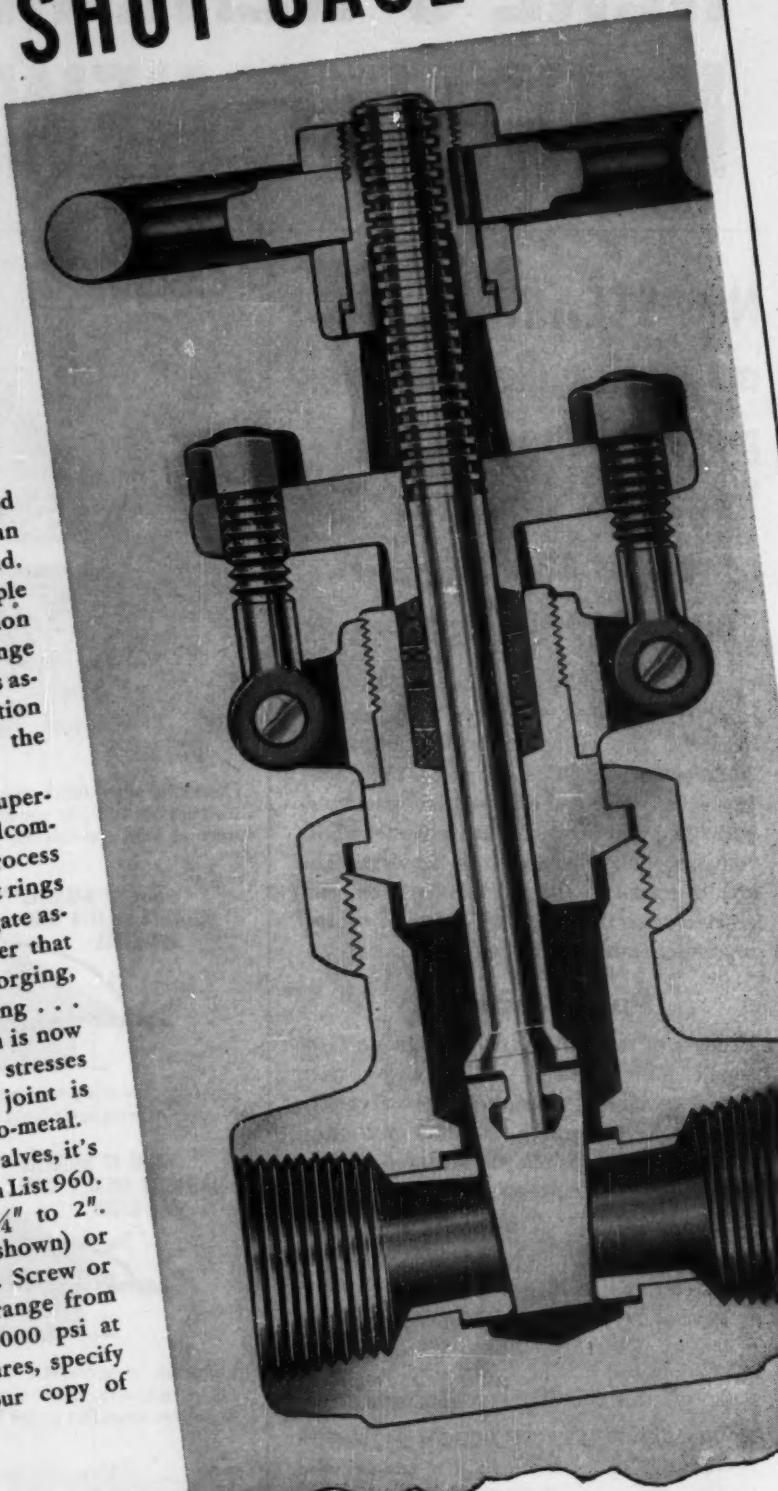
## Small Forged Steel Gate Valves



Chapman List 960 is used for more different jobs than any other valve of its kind. And no wonder: its simple and rugged construction means reliability over its wide range . . . super-hardened gate and seats assure tight closure, smooth operation and low maintenance under the toughest conditions.

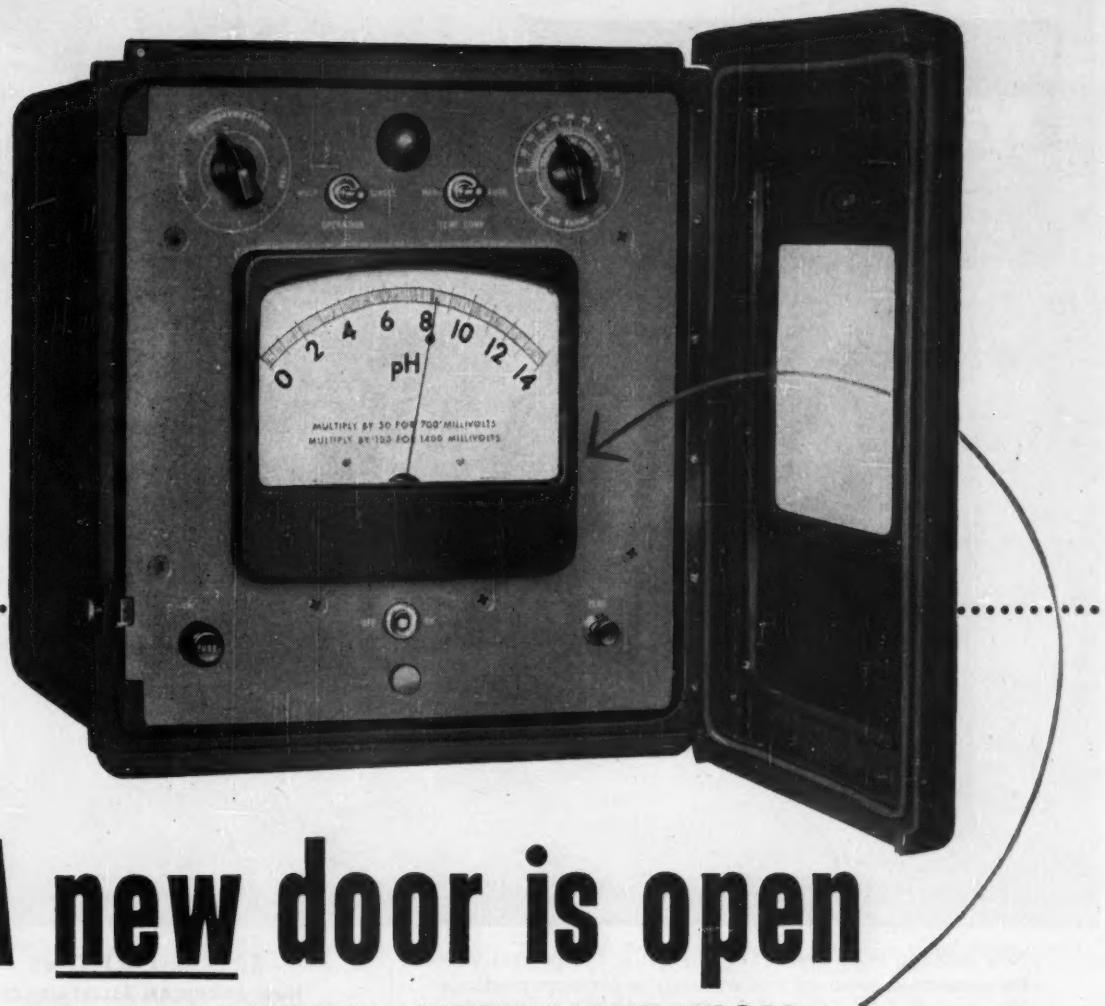
Here's why: gate faces are super-hardened to 800 Brinell by Malcomizing, Chapman's exclusive process . . . hardened stainless steel seat rings are replaceable . . . stem-and-gate assembly has a tapered shoulder that seats snug in the bonnet forging, permits full-pressure repacking . . . 50% stronger where high stresses can develop . . . bonnet joint is gasketed or ground metal-to-metal.

For big savings on small valves, it's a winning case for Chapman List 960. Available in sizes from  $\frac{1}{4}$ " to 2". Rising stem, with yoke (shown) or inside screw, rising stem. Screw or welding ends. Pressure range from 380 psi at 1000°F to 2000 psi at 100°F. For higher pressures, specify List 990. Write for your copy of Catalog 10 now.

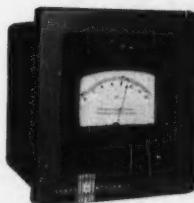


The **CHAPMAN VALVE**  
MANUFACTURING COMPANY

Indian Orchard, Mass.



# A new door is open TO pH & REDOX INSTRUMENTATION



Here's the modern approach to process pH—a continuously measuring Panel-Mounted pH Indicator. This timely industrial version of our widely accepted Stabilized Bench-Type Indicator gives a 24-hour-per-day check on pH or redox with the same 0.02 pH accuracy as its lab-type counterpart.

The versatile Indicator offers a number of monitoring possibilities. Primarily a point-of-measurement indicator, it can also actuate remote meters (scale and pointer only) or a simple potentiometer recorder. Or, several Indicators, spotted through the process, can indicate locally and feed their respective values to one multiple-point Speedomax® recorder.

#### ONLY L&N BUILDS THESE STANDARD FEATURES IN A PROCESS pH INDICATOR

**Low warm-up time** of less than 1 minute for accurate readings. No de-humidifying period to wait. No desiccants required.

**Unaffected by "error-inducers"** such as line voltage surges, electrical pick-up, and zero drift.

**No modifications in grounding system needed** to measure grounded or ungrounded solutions.

**Completely enclosed case** keeps out water or corrosive fumes.

**Manual and automatic temperature compensation** in one Indicator. Switch to either as desired.

**Simple maintenance** by operating personnel. Conventional wiring with printed components makes service items inexpensive and easy to install. Entire chassis can be changed in only 60 seconds.

**Highly accurate** without recourse to external meters or recorders. Design takes advantage of exclusive features of L&N electrodes.

**0 to 14 pH range** in 0.1 pH div. 0 to 700 mv. in 5 mv. div., and 0 to 1400 mv. in 10 mv. div.

**Die cast aluminum case** only 12" x 11" x 11".

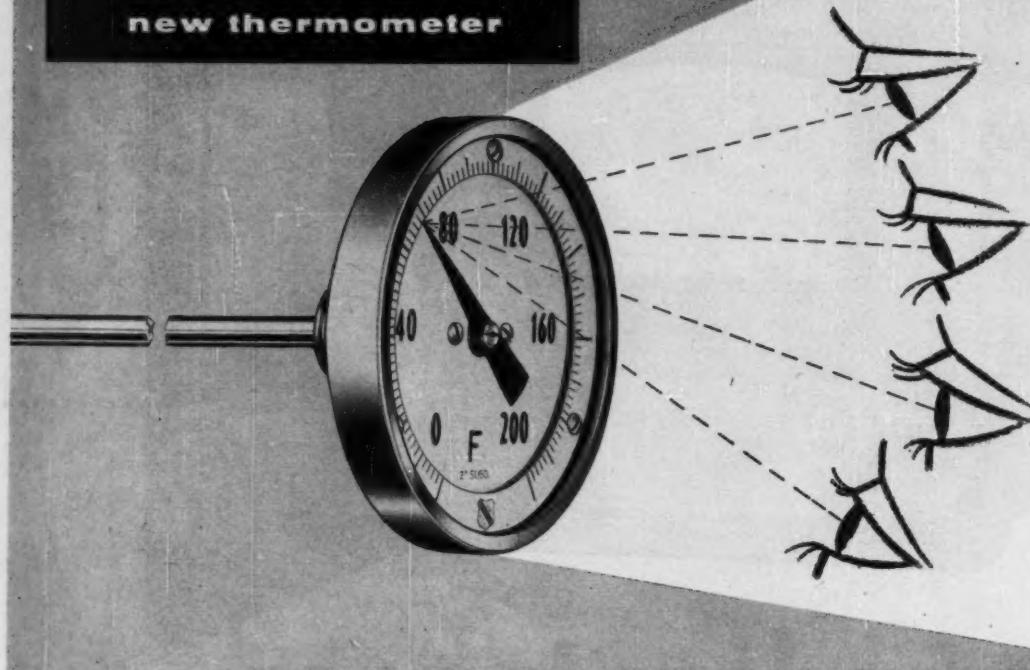
**List numbers**—7678 (115 v., 50 to 60 cycles); 7679 (230 v., 50 to 60 cycles).

For details, write to Leeds & Northrup Co., 4916 Stenton Ave., Phila. 44, Pa., for Data Sheet ND42-96(1).

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instruments

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automatic controls • furnaces

**ANTI-PARALLAX  
MAXIVISION**  
Is yours in this  
new thermometer



Now you can read temperatures right at the process with the same ease, accuracy and economy as pressure readings. The Anti-Parallax Maxivision Dial on this new all stainless steel American Bi-Metal Thermometer assures these important advantages. The large, easy-to-read black figures and graduations are carried on a raised ring set close to the glass, with pointer at the same level. Parallax error is practically eliminated.

With this new thermometer in service, field operators can eliminate frequent trips to the control house to observe process changes. Indoors or outdoors, this fine, all stainless steel American instrument is truly climate-proof. Because the case is only 3" in diameter, the thermometer fits where space is limited. Ample clearance behind the case makes installation easy and fast with a small wrench. Read the specification highlights, then get full details about this new high-accuracy American Bi-Metal Thermometer.



PHONE your Industrial Supply Distributor for prompt attention to your needs. He is always ready to help keep your production going by making fast delivery from local stocks.

#### SPECIFICATIONS

**New AMERICAN ALL-STAINLESS STEEL BI-METAL THERMOMETER with ANTI-PARALLAX MAXIVISION DIAL**

**Dial:** Exclusive anti-parallax Maxivision dial, with scale approximately 6" long. Pointer set at same level as scale.

**Climate-Proof Case:** All stainless steel. 3" diameter. Threaded bezel. Selected clear, extra-heavy cover glass. Heat-resistant gaskets between glass and case seal the thermometer against rain, frost, sand, dust, fumes—climate-proof.

**Temperature Ranges:** From minus 80° to plus 1000° F. Accuracy within 1% of range.

**Low-Mass Bi-Metal Coil:** Welded to stem plug. Accurately centered in stem. Non-freezing, non-corrosive silicone fluid on coil dampens vibration, accelerates heat transfer, speeds response; does not gum, resists capillary action.

**Pointer:** Index type. Easily accessible from front of dial for positive adjustment over entire range. Pointer shaft guided by friction-free bearings.

**Stem:** 18-8 stainless steel, mirror polished. All joints welded. Resists corrosion. Provides strong, rigid and tight closure against process pressures. Lengths: 2½" to 24".

**Connection:** Fixed, ½" N. P. T.

**Separable Sockets:** Available for use in closed systems or where measured medium is corrosive to the stainless steel stem. Fit over all standard stem lengths except 2½".

## AMERICAN INDUSTRIAL INSTRUMENTS

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MAKERS OF 'ASHCROFT' GAUGES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, Stratford, Conn. HANCOCK VALVES, Watertown, Mass. 'CONSOLIDATED' SAFETY RELIEF VALVES, Tulsa, Oklahoma. AIRCRAFT CONTROL PRODUCTS, Danbury & Stratford, Conn. and Inglewood, Calif. "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, Muskegon, Mich.



## Dependable Source for Chemical Raw Materials



*Lee O'Leary, purchasing agent, Ansul Chemical Co., Marinette, Wisc., and Russell Brustmann, assistant purchasing agent, discuss Ansul's basic chemical requirements with J. C. Mills, a representative of Wyandotte Chemicals.*

## "Wyandotte developed a new product to meet our specifications!"

*- Lee O'Leary, p.a., Ansul Chemical Co., Marinette, Wisc.*

In the little booklet that welcomes visitors to the Ansul Chemical plant at Marinette, Wisc., this statement can be found: "Ansul is more than a chemical company—it is a unique combination of a chemical-mechanical manufacturing concern."

"In all of our activities," states Lee O'Leary, Ansul's purchasing agent, "we have had to set some pretty rigid specifications, in order to maintain our own high quality. These, of course, apply to chemical ingredients.

"The chemical industry was most co-operative in helping us

to realize our ambitions. Take Wyandotte, for example. Their research and production departments worked together to develop a new product to meet our unusual specifications.

"During this period, Wyandotte Field Representatives and Technical Service men worked very closely with us. Today, we enjoy the same fine co-operation from Wyandotte, at all levels."

If you want a source of chemical raw materials that you can count on, year after year, for uniform quality and dependable service, try Wyandotte. In writing, give as much of the back-

ground of your needs as possible, in order to expedite our information to you. *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Offices in principal cities.*

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Chlorinated Solvents • Synthetic Detergents • Agricultural  
Insecticides • Other Organic and Inorganic Chemicals.

for either of these  
**CHEMICAL PUMPING**  
needs... specify

**ALDRICH**

**AUTOMATICALLY  
CONTROLLED  
DELIVERY**

**MEDIUM to  
HIGH PRESSURE  
SERVICE**

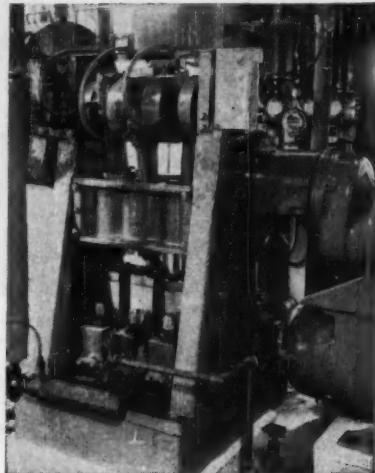
**FOR AUTOMATICALLY CONTROLLED DELIVERY** use an Aldrich-Groff "POWR-SAVR." This variable stroke triplex pump controls delivery from 0 to 100% of capacity at constant pump and motor speed . . . can be controlled from any remote point, manually or automatically. Power requirements are low, because consumption is directly proportional to demand.

"POWR-SAVR" pumps handle any free-flowing liquid at discharge pressures from 300 to 15,000 psi and are available in six sizes—from 2" to 6" stroke and from 5 to 125 bhp. For more information on these versatile pumps, write for Data Sheet 65.

**FOR MEDIUM TO HIGH PRESSURE SERVICE** several types of constant stroke pumps are available—depending upon the service involved. You may need the Inverted Vertical Triplex (Data Sheet 66), the Vertical Triplex (Data Sheet 26), or the Direct Flow Triplex or Multiplex Pump (Data Sheets 64, 64B). (All these helpful data sheets are available upon request.)

From our experience in building pumps for the chemical industry, we can—from our engineering and service files—frequently make specific recommendations to meet your chemical pumping needs. Whatever your problem, we welcome your inquiries.

Aldrich Pumps are ideal for applications involving corrosion, abrasive materials, high viscosity or high pressure. Among many liquids handled by Aldrich Pumps are: caustic solutions, fatty acids, nitric acid, acetic acid, aqua ammonia, anhydrous ammonia, as well as liquids encountered in the petroleum refining, petroleum chemical, and other industries.



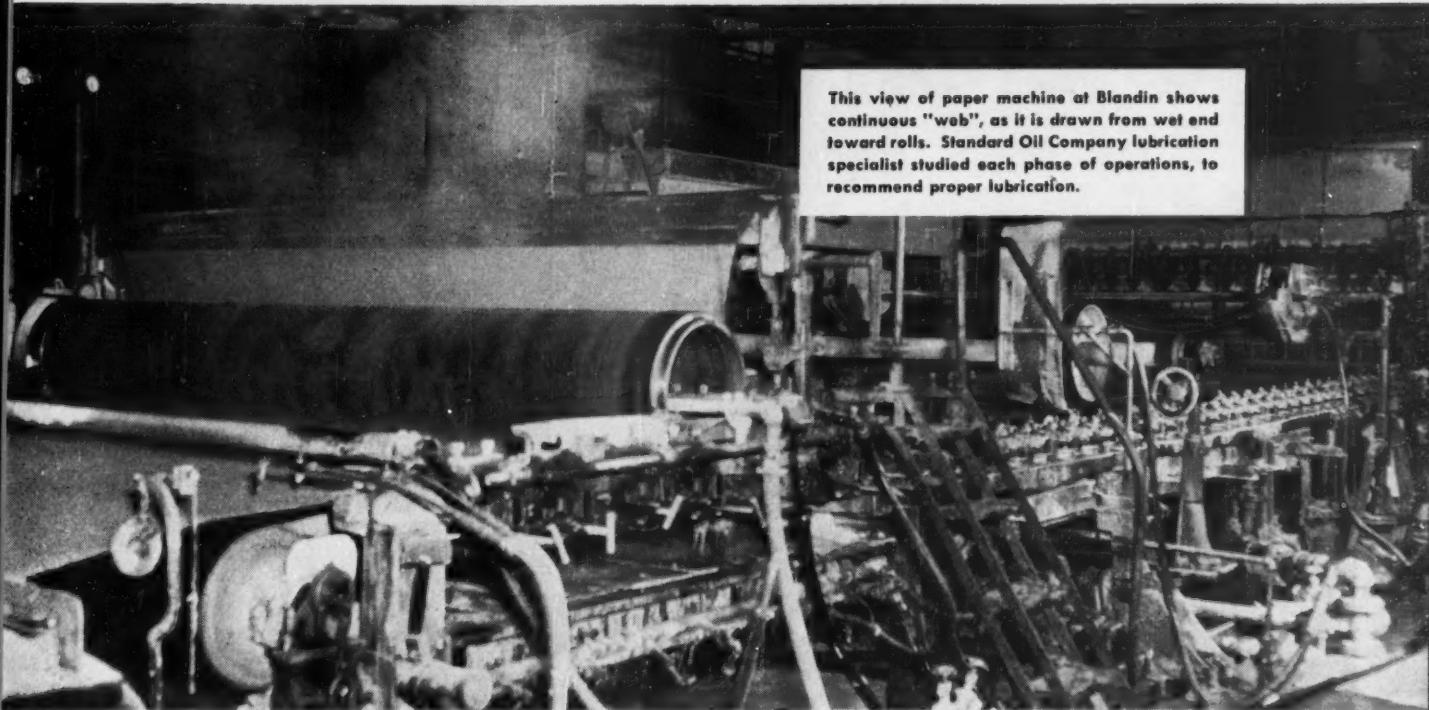
This Aldrich Vertical Triplex Pump—on the job at the Burlington, N. J., plant of Hercules Powder Company—is employed to pump rosin ester in the manufacture of Abitol, hydro-abetyl alcohol, used in lubricants and in the manufacture of alkyd resins. In this application pump capacity is one gallon per minute against 6,000 pounds discharge pressure.

THE **ALDRICH** PUMP COMPANY  
3 GORDON STREET • ALLENTOWN, PENNSYLVANIA

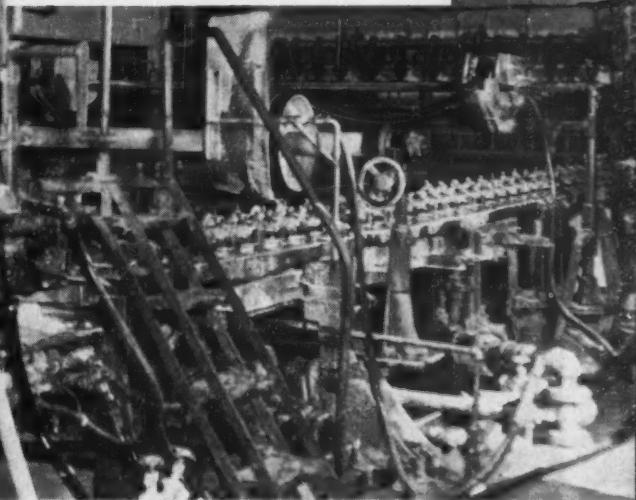
} ...Originators of the  
Direct Flow Pump

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# **STANOLITH GREASE overcomes trouble spot, keeps paper rolling at BLANDIN**



This view of paper machine at Blandin shows continuous "web", as it is drawn from wet end toward rolls. Standard Oil Company lubrication specialist studied each phase of operations, to recommend proper lubrication.



STANOLITH Grease aided the solving of a rough lubrication problem at Blandin Paper Company in Grand Rapids, Minnesota.

A bottleneck on the paper making machines threatened production at this hustling paper plant four years ago. The trouble occurred near the beginning of the process, where the pulp contains up to 99% water. At this point, bearings are greeted by a shower of water and stock.

Greases were quickly lost, literally washed away. Bearings were ruined early in life. Not only had greases failed in their duty but they caused paper staining.

A Standard Oil lubrication specialist recommended STANOLITH Grease for use on the wet end of the paper machine. It did such a good job that Blandin maintenance personnel put this multi-purpose grease to work on other applications, too. Now, except when open gear and brick greases are required, STANOLITH serves the entire plant, replacing a wide number of single-duty products.

STANOLITH is truly a multi-purpose grease. It may be used almost anywhere on the job, in mechanical or hand-operated dispensers. STANOLITH Grease is heat and water resistant. It will reduce grease inventories, eliminate waste and prevent costly application errors. Find out more about how STANOLITH Grease can help you do many tough lubrication jobs with just *one grease!* In the Midwest call your nearby Standard Oil lubrication specialist. Or contact Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

Blandin maintenance man, Fred Harwood (left), and I. A. Westerlund, Standard Oil lubrication specialist, inspect a table roll bearing. This is just one of many places in the plant where STANOLITH Grease provides top-efficiency lubrication.

I. A. Westerlund is a graduate of the University of Minnesota with an engineering degree. He is also a graduate of Standard's Sales Engineering School, and makes good use of his training in providing technical service to customers. He's been doing this for 14 years. His customers find this experience and training pay off for them.



**STANDARD OIL COMPANY (Indiana)**



## No maintenance problems with this instrument!

In spite of all of the development work being done on automatic control instruments, the Bristol Series 500 Air-Operated Controller is still the most dependable and trouble-free — as proved by thousands of installations. And here's why:

**It's the simplest to service.** Only one adjustment with a  $\frac{1}{16}$  in. wrench calibrates the control system. No other adjustment is needed. Control system can be completely disassembled and, after reassembly (even with replacement parts), can be exactly calibrated by this one simple adjustment.

**It's completely reliable.** One user states, "I'm amazed at the way this instrument performs day-in and day-out with little or no attention. We call it the work-horse controller in our plant. And our plant men like to use it, because it gives them the precision results they need without having to fuss with it".

**Its settings are exactly reproducible.** Reset rate, deriv-

ative time, and proportional band adjustments are accurately calibrated and exactly reproducible. You can instantly reproduce established settings without cut and try.

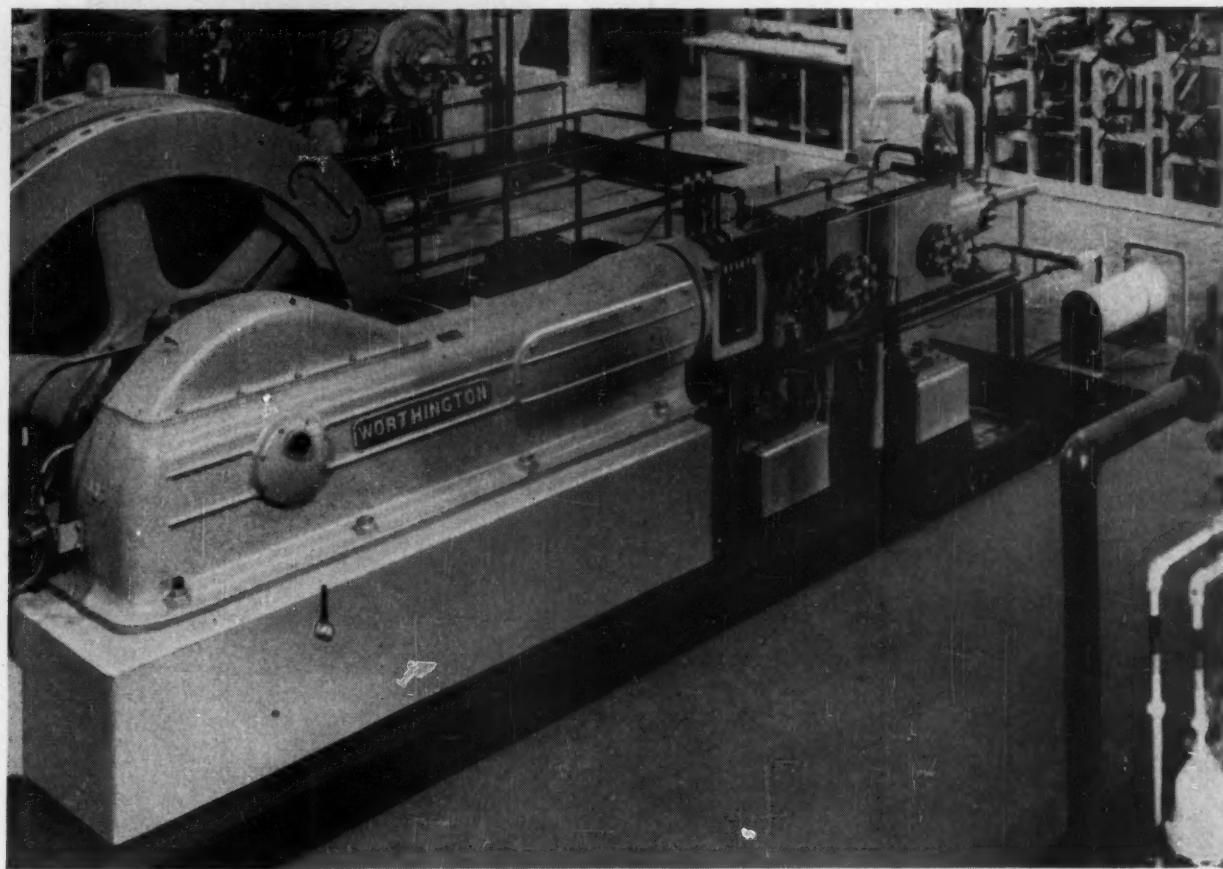
**It uses the world-famous Bristol measuring elements.** The measuring systems used in Bristol Series 500 Air-Operated Controllers for TEMPERATURE, PRESSURE, FLOW, VACUUM, DRAFT, ABSOLUTE PRESSURE, LIQUID LEVEL, pH, AND HUMIDITY are the result of 65 years of experience in instrument making and application in practically every industry. Bristol measuring elements are recognized the world over for their accuracy, simplicity, and reliability. There just aren't any better measuring elements made than Bristol's.

For more facts and figures about the Series 500 Air-Operated Controllers, write for free 32-page bulletin A120. The Bristol Company, 109 Bristol Road, Waterbury, Connecticut.

4.27

**BRISTOL** POINTS THE WAY IN  
HUMAN-ENGINEERED INSTRUMENTATION

**AUTOMATIC CONTROLLING, RECORDING AND TELEMETRY INSTRUMENTS**



**HIGH-PRESSURE WORTHINGTON RECIRCULATOR-COMPRESSORS** help to manufacture synthetic ammonia at the Hooker Electrochemical Company in Tacoma, Washington. Gaseous nitrogen and hydrogen are compressed, circulated through a catalyst, and converted under maintained pressure and temperature into synthetic ammonia. The Chemical Construction Corporation of New York engineered this installation.

## Hooker uses efficient Worthington unit in $\text{NH}_3$ synthesis

The Hooker Electrochemical Company in Tacoma needed a recirculator-compressor that would operate dependably and efficiently at the extremely high pressures involved in the manufacture of synthetic ammonia.

Worthington answered this need by supplying a Worthington High-pressure Recirculator-Compressor, with a discharge pressure of over 5000 psig. This was a routine operation for Worthington engineers, since they have furnished similar units on many previous occasions.

The compressor cylinder, complete with packing boxes, is a one-piece forging. The piston rod, piston and tail rod are also integrally forged. These features insure the ac-

curate alignment essential to successful operation of high pressure equipment. And this alignment is maintained throughout years of operation.

This is another example of the way a manufacturer benefits by Worthington's skilled application engineering and the completeness of the Worthington line. Because Worthington manufactures compressors of every size and type, there's a Worthington machine that will exactly fit *your* needs. Get in touch with your nearest Worthington district office, or write to Worthington Corporation, Compressor Division, Section K.3.2, Buffalo 5, N. Y.

K.3.2

"SEE the Worthington Corporation Exhibit in New York City. A lively, informative display of product development for industry, business and the home. Park Avenue and 41st Street."

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**Only Worthington Compressors give you Feather Valve Performance**

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# **WALWORTH VALVES** on the job in the **chemical industry**

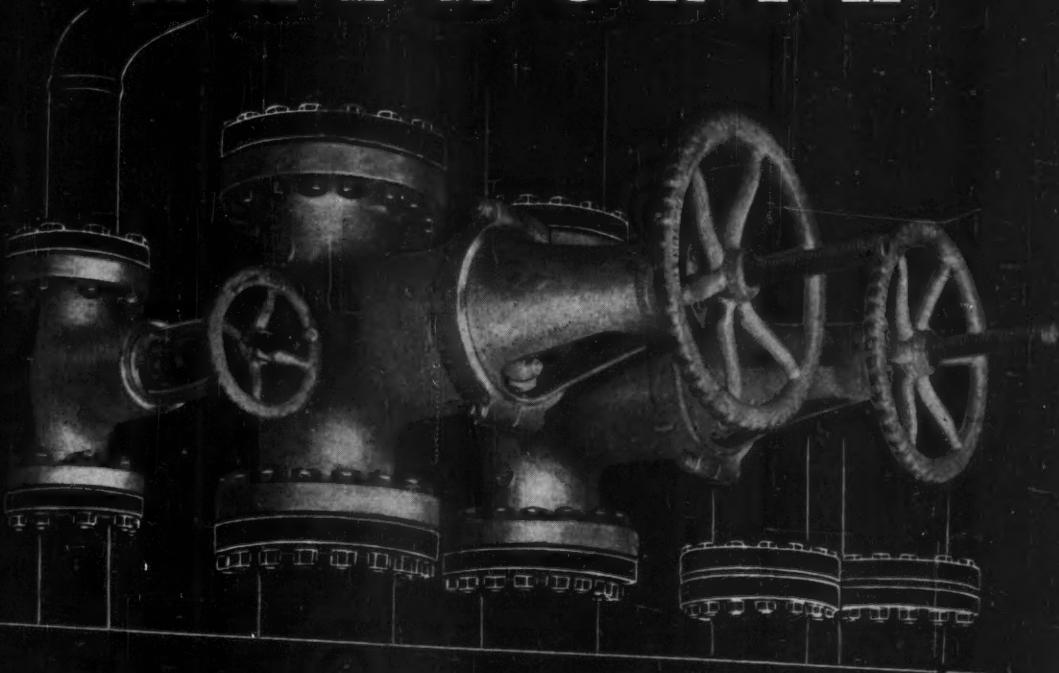
Shown below are three differential converter units used by a large eastern chemical company\* in controlling flow of inhibitor oil. Walworth Bronze Valves are used extensively in the piping to and from the converters and recording instruments.

Your Walworth Distributor stocks complete lines of Walworth Valves and Walworth Pipe Fittings for use throughout the chemical industry. For your needs contact the Walworth Distributor nearest you. Walworth Company, General Offices, 60 East 42nd Street, New York 17, New York.

\*Name on request



# WALWORTH

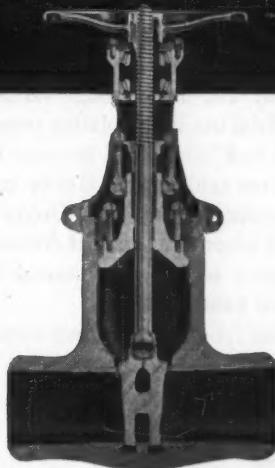


## **PRESSURE-SEAL CAST STEEL VALVES**

*Better because* ... They have no bonnet flanges, bonnet bolts, or bonnet welds. Ideal for high-pressure, high-temperature steam service and corresponding boiler feed service, Walworth Pressure-Seal Cast Steel Valves weigh less, and take up less space than the flanged bonnet type of valves used for similar services.

These are a few of the important advantages made possible by the design of Walworth *Pressure-Seal* Cast Steel Valves. Internal line pressure is utilized within the bonnet to maintain a tight, leakproof, body-to-bonnet connection under all normal operating conditions. The higher the pressure, the tighter the seal.

Ask for your copy of Walworth Circular 143. It gives detailed information, including sizes, dimensions, and specifications for all Walworth *Pressure-Seal* Cast Steel Valves.



Cross section of 8-inch Series 900 Walworth Pressure-Seal Cast Steel Gate Valve. Pressure-Seal Globe, Check, Angle, and Non-Return Valves are also available in Series 600, 900, 1500 and 2500 in a wide range of sizes.

# WALWORTH

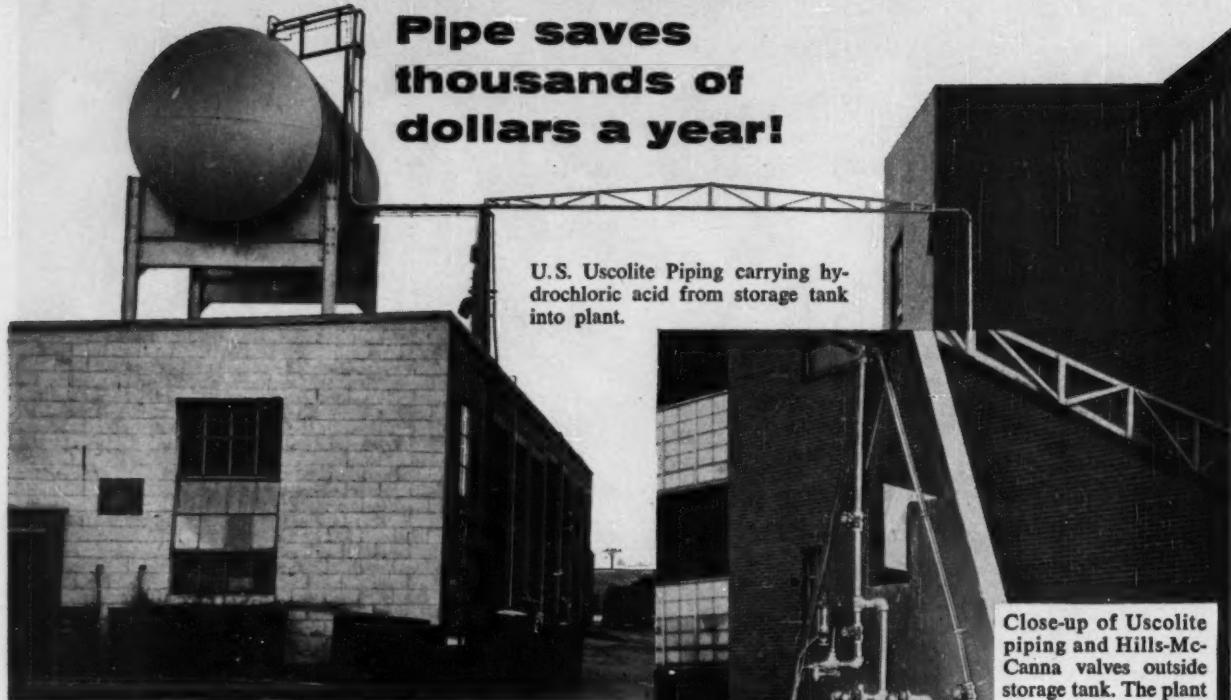
Manufacturers since 1842

valves . . . pipe fittings . . . pipe wrenches

60 East 42nd Street, New York 17, N. Y.

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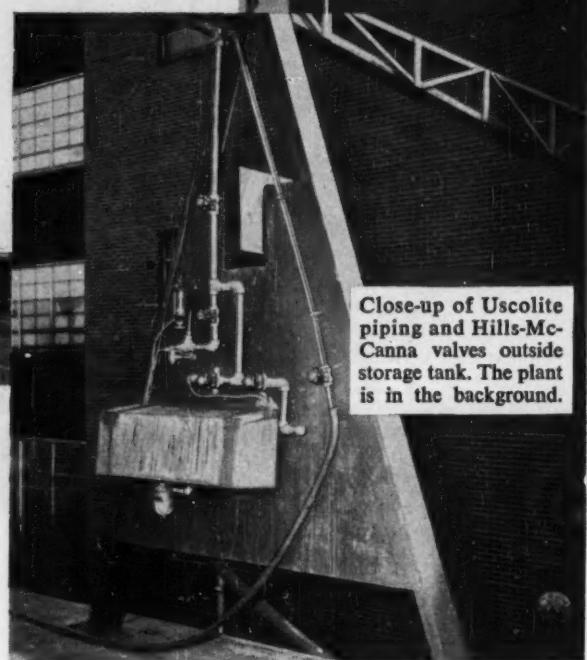
# New acid-handling system incorporating **U. S. Uscolite** **Pipe saves** **thousands of** **dollars a year!**



A large Eastern manufacturer of lighting and signaling systems uses 300 feet of Uscolite® plastic pipe to carry hydrochloric acid from storage tanks outside the plant across an areaway, and then through various production departments to final use in the plating room. Previously, carboys of acid had been used, because the plant had no facilities to store acid in bulk. But by installing a new acid-handling system, using U. S. Uscolite piping and fittings, the plant saves thousands of dollars a year—they now *buy and store in bulk*. Additional thousands are saved by reduced handling costs.

The plant also fabricated its own fume hoods from

Close-up of Uscolite piping and Hills-McCanna valves outside storage tank. The plant is in the background.



Uscolite sheet stock, for use in the plating operation. The plant engineer is pleased because Uscolite's unusual mechanical strength enables it to be left exposed in any weather, and to be run overhead through various parts of the plant without fear of damage to men or machines. Hills-McCanna Uscolite valves are used in the piping assembly.

Made by United States Rubber Company, Uscolite is light in weight with high impact strength. It is solving acid and corrosion problems in every industry. The piping can be easily threaded and installed with conventional tools. For replacements or a completely new piping system, get in touch with any of our 27 District Sales Offices, or write to address below.

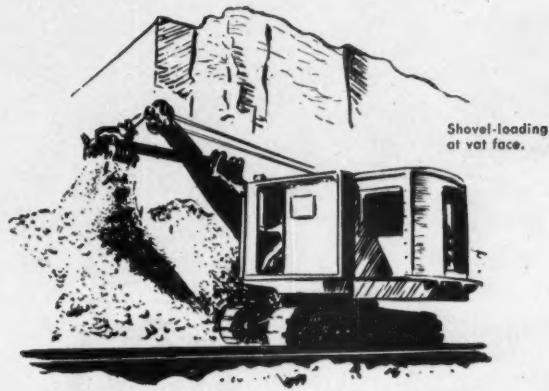


Uscolite pipe and fittings are made in the broadest and largest line of stock sizes on the market.



**"U.S." Research perfects it... "U.S." Production builds it... U.S. Industry depends on it.**  
**UNITED STATES RUBBER COMPANY**  
**MECHANICAL GOODS DIVISION • ROCKEFELLER CENTER, NEW YORK 20, N. Y.**

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Shovel-loading  
at vat face.

# Crude Sulphur

for Industrial Use

*from  
the  
properties  
of*

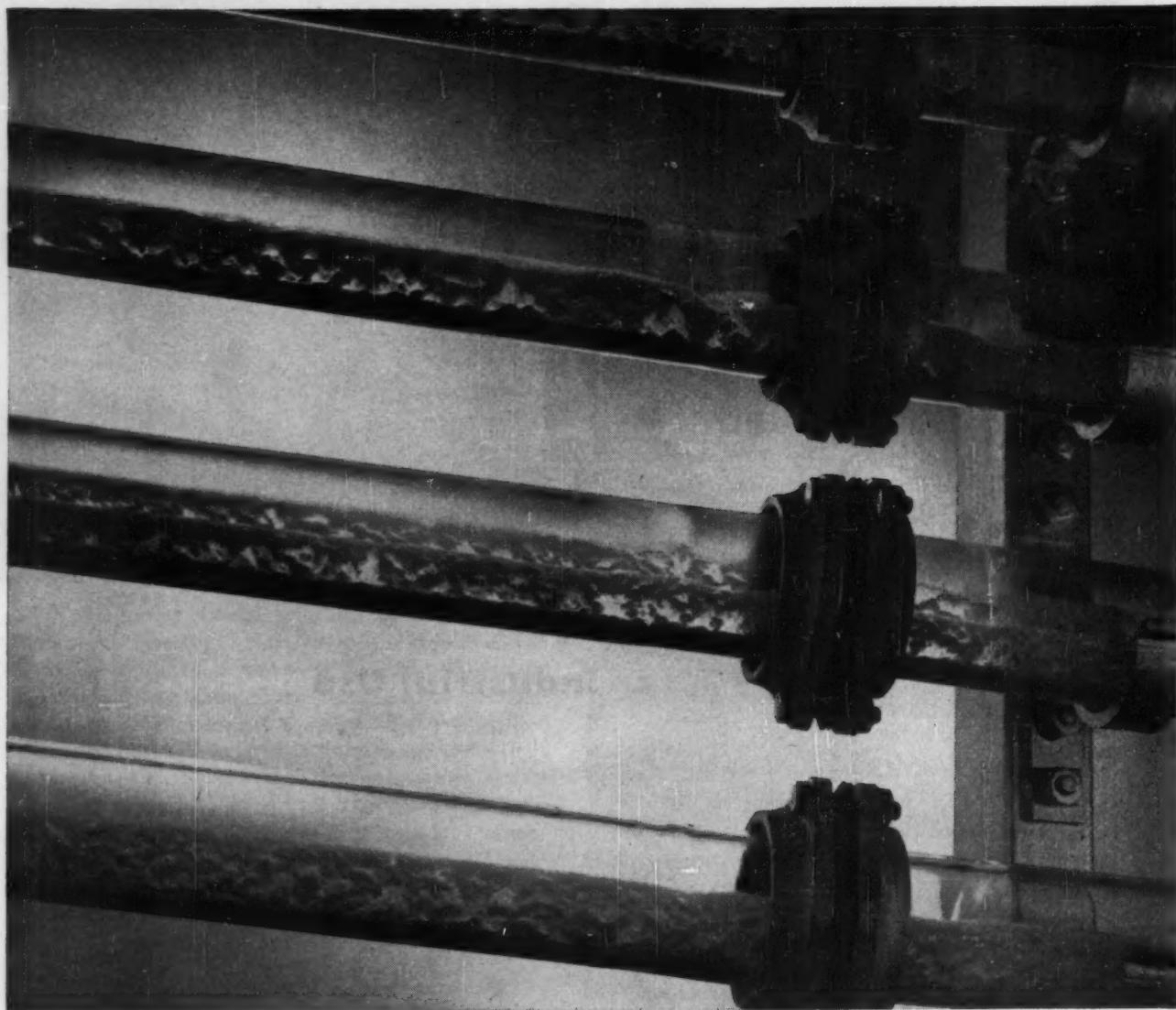
## Texas Gulf Sulphur Co.

75 East 45th Street • New York 17, N. Y.

Producing Units

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- MOSS BLUFF, TEXAS
- SPINDLETOP, TEXAS
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## Are you missing the



You'll find that PYREX pipe does a superior job with such acids as sulphuric, hydrochloric, nitric, and acetic; and with such materials as chlorinated hydrocarbons, hydrogen peroxide, bromine, brines, and low-concentration alkaline solutions.

### MORE INFORMATION FOR YOU

Space doesn't permit us to describe in detail all the advantages of using PYREX pipe—its clear transparency (you're almost certain to find this a great convenience); how you can plumb it in your own plant to meet any layout requirements; its relatively light weight; comparative costs. So let us send you any or all of the bulletins listed in the coupon on the opposite page.

You need only fill out the coupon and mail it to us for prompt action. Or, if you prefer to discuss your own specific problem immediately with one of our representatives, write, wire, or phone us, or our nearest distributor.

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# corrosion resistance of PYREX® pipe

## because you think it will break?

LOOK what one plant manager says. "There was no breakage during installation. There have been no lines broken because of the product handled, the temperatures involved, or the age of the pipe. There has been no accidental breakage. In short—there has been *no breakage*."

Every "product" line in this plant has been PYREX pipe since 1943. The company switched to PYREX pipe because metal lines were quickly corroded by the acids in the products handled. Corrosion in the metal piping also made cleaning difficult, and the frequent replacements made maintenance very costly.

Thousands of engineers and operating men in hundreds of plants across the country have had the same experience with millions of feet of PYREX brand glass piping. If you are not enjoying the trouble-free corrosion resistance of PYREX pipe, because you are worried about breakage, why not talk to some of the people who are using it daily.

- We will be delighted to furnish you with the names of companies near you.

### You can install it easily

More than 75% of the PYREX pipe now in use has been installed by our customers' own pipfitters. Proper installation is a relatively simple matter; you can plumb it in your

own plant to meet any layout requirements. It is easier to hang than many other kinds of corrosion resistant pipe, as there are no special hard-to-catch-on-to tricks about it. Our installation manual covering every detail is yours for the asking. And remember, once your PYREX pipe is in place, you can count on it for a lifetime of service.

### Why PYREX pipe today is more durable than ever

The greatest strain on any type of pipeline is usually set up at the joints due to misalignment or lack of flexibility. To offset any such strain, all PYREX pipe ends and fittings (except U-bends) are now tempered, which makes them up to four times stronger than previous fittings. In fact, we know of instances where the metal bolts have been accidentally tightened to their breaking point without the glass yielding. Alignment of lines is also easier now because of improved gasketing materials, inserts and a complete line of spacers and adjustable joints.

### Maintenance problems can be reduced

The liquid smooth surface of PYREX pipe does not pit. Deposits do not build up, so your product lines keep up to planned volume. Cleaning is simple, when necessary, as you can

| RECOMMENDED WORKING PRESSURES—TEMPERATURES |                                      |   |                               |
|--|--------------------------------------|---|-------------------------------|
| Pipe Size                                  | Maximum Recommended Working Pressure | Maximum Sudden Temperature Differential | Maximum Operating Temperature |
| 1"   | 50 p.s.i.                            | 200° F.                                 | 450° F.                       |
| 1½"  | 50 p.s.i.                            | 200° F.                                 | 450° F.                       |
| 2"   | 50 p.s.i.                            | 200° F.                                 | 450° F.                       |
| 3"   | 50 p.s.i.                            | 200° F.                                 | 450° F.                       |
| 4"   | 35 p.s.i.                            | 175° F.                                 | 450° F.                       |
| 6"   | 20 p.s.i.                            | 160° F.                                 | 450° F.                       |

see the interior of the pipe at all times. Most users find their pipeline maintenance problems are reduced to a periodic inspection of joints and occasional tightening of flange bolts. One plant superintendent said, "Since PYREX pipe was installed for all of our product lines, maintenance has been practically nil."

### What does it cost?

Initial cost of PYREX pipe compares favorably with most other corrosion resistant piping . . . and it is less expensive than some. Subtracting low installation cost, economical maintenance and long-time service from initial cost puts PYREX pipe on the profit side of your plant budget instead of the cost-of-operating side.

| STANDARD SIZES PYREX BRAND GLASS PIPE |            |                        |                      |                          |
|---------------------------------------|------------|------------------------|----------------------|--------------------------|
| I.D., Inch                            | O.D., Inch | Mean Wall Thick., Inch | Stock Lengths (Feet) | Approx. Weights Lbs./Ft. |
| 1"                                    | 1 1/8      | 3/32                   | 5/8 to 10            | 0.6                      |
| 1½"                                   | 1 7/8      | 11/64                  | 5/8 to 10            | 1.0                      |
| 2"                                    | 2 1/8      | 11/64                  | 5/8 to 10            | 1.3                      |
| 3"                                    | 3 1/8      | 13/64                  | 5/8 to 10            | 2.0                      |
| 4"                                    | 4 1/2      | 17/64                  | 5/8 to 10            | 3.4                      |
| 6"                                    | 6 5/16     | 21/64                  | 5/8 to 10            | 6.3                      |



CORNING GLASS WORKS, CORNING, N. Y.

*Corning means research in Glass*

CORNING GLASS WORKS, 11 Crystal St., Corning, N.Y.

Please send me the bulletins checked below:

- EA-1: "PYREX Pipe in the Process Industries" (Illustrated case histories)
- EA-3: "PYREX brand 'Double-Tough' Glass Pipe and Fittings Catalog"
- PE-3: "Installation Manual for PYREX Pipe"
- Please have your representative call on me.

Name..... Title.....

Company.....

Street.....

City..... Zone..... State.....

|   |   |  |
|---|---|--|
| <b>Material:</b> Activator solution—water with 5% ferro-sulphate.   | <b>Material:</b> Anti-scale boiler treatment. (Alcohols, oils, anti-foam agents, sludge conditioners.)            | <b>Material:</b> Caustic solution—for use in mercerizing machines.   |
| <b>Problem:</b> Short service life of turbine pumps; sometimes only two weeks.  | <b>Problem:</b> Frequent pump breakdowns caused by back pressure of spray nozzles; and abrasion.                  | <b>Problem:</b> Rotary pumps wore quickly; lost capacity, and did not have enough suction.                                   |
| <b>Solution:</b> First Moyno ran 6 months without a breakdown. Using relief valves, pressure is kept at constant 120 p.s.i. Now using 7 Moynos because of this exceptional service. | <b>Solution:</b> Moyno pumps cut pumping time from 20 minutes to 3, reduced down-time, increased production 200%! | <b>Solution:</b> Moyno pumps cut maintenance and repairs to minimum—had ample suction for drawing caustic through the cloth. |

## Six Chemicals-Handling Problems... Solved by the MOYNO® PUMP!

### Features of the MOYNO that may solve YOUR pumping problem

**Positive Displacement**—Moynos are available to pull up to 29" vacuum while discharging under pressure. Big Moynos deliver up to 250 g.p.m. at pressures to 600 p.s.i.

**Gentle**—No churning; won't break up semi-solids; won't aerate liquids.

**Reversible**—The Moyno pumps with equal efficiency in either direction.

**Versatile**—handles liquids, abrasive slurries, pastes—even potato salad! Rotor and stator are available in stainless steel, other alloys or plastics to meet a wide variety of applications.



**Trouble-Free**—self priming; won't cavitate or vapor-lock. Just one moving part—no valves to stick, no pistons to gum up. Built for tough service. Easy to maintain.

Looking for a pump with a fast-growing reputation for solving tough pumping problems? Then take a look at the simple, versatile Moyno!

Briefly described above are a few of the many successful case histories proving how Moynos handle jobs where other pumps fail. Why is the Moyno a "problem-solving" pump? For one thing, because it differs completely from conventional pumps . . . rotary, centrifugal or piston. Just one rugged moving part—a rotor turning within a stator—does the job.

The list of chemicals handled by Moynos gets longer every day. If you have a pumping problem, such as handling abrasive slurries, mild acids, caustics—watery, viscous or even semi-solid—find out if the Moyno can help you! Use the coupon below for prompt, complete information.

Robbins & Myers, Inc.  
Pump Division, Springfield 99, Ohio

CE

Gentlemen: Please mail free copy of Bulletin 39-B containing details on construction and operation of Moyno Pumps:

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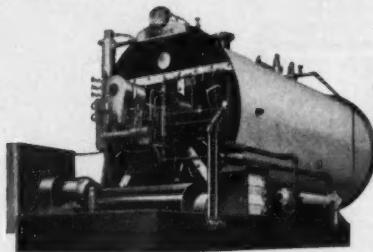
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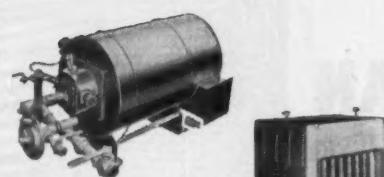
Superior Burners burn oil or gas or a combination of both... changing from one fuel to the other in seconds.

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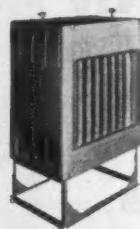
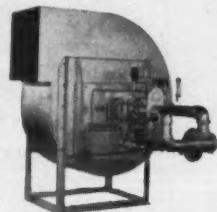
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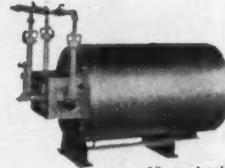


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CE-1

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without interrupting  
production or  
contaminating the  
product

Here's positive and 100%-continuous fluid cleaning.

Cuno AUTO-KLEAN Strainer is the *only* fluid cleaner on the market that works uninterruptedly. It's continuously-cleanable without stopping flow and without dismantling. An occasional turn of a handle—while in operation—combs out dirt accumulations. This can also be done *automatically*.

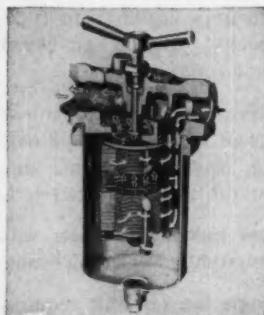
Thus—no loss of production, no chance of contaminating the product from exposure during element cleaning or replacement.

There's nothing to wear out and need replacement. All-metal Cuno AUTO-KLEAN Strainer will last as long as the equipment on which it is installed.

Models available for straining from .0035 to .062 in., a wide range of fluids, viscosities up to and above 300,000 SSU. Sizes to handle from a few to more than 4000 gpm. Send coupon for specific information about your fluid-straining problems.



**NON-STOP CLEANING** Turning metal discs past cleaner blades (periodically by hand or continually by motor or other automatic means) "combs out" all solids—even when imbedded in strainer element—without interrupting flow.



CUNO AUTO-KLEAN Strainer is guaranteed to remove all particles larger than specified.



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*Fluid Conditioning*

Removes More Sizes of Solids  
from More Types of Fluids

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Please send me a free copy of your AUTO-KLEAN bulletin. I am especially interested in the services checked.

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Positive Chopping Action. Feed  
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Many in Continuous Service for  
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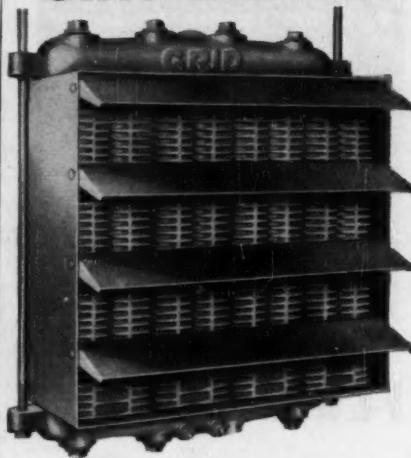
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reasons  
why the  
chemical  
industry  
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**ALL CAST IRON CONSTRUCTION**

**1** GRID is a completely different unit heater . . . its all cast iron construction stands up well against corrosive acid fumes of HCl, Cl<sub>2</sub>, etc. GRID Unit Heaters have provided trouble-free service for over 24 years in the chemical industry.

**WITHSTANDS STEAM PRESSURE  
UP TO 250# P.S.I.**

**2** GRID is an all cast unit with finned heating sections and headers that are tested to withstand steam pressures up to 250# P.S.I. Its GRID construction uses no brazed, soldered, rolled or welded connections between condenser and headers. GRID has all similar metals in contact with steam, preventing electrolytic corrosion which eventually occurs in copper type unit heaters where steam passes from iron pipes into copper cores.

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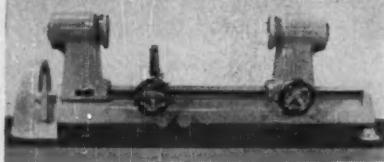
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LATHES**



**MODEL HSA**

\$1335.00 f.o.b. Grass Valley, Calif.

**GENERAL SPECIFICATIONS**

|  |                    |
|--|--------------------|
| Maximum length overall . . . . .                         | 63½"               |
| Maximum width overall . . . . .                          | 18½"               |
| Maximum length spindle nose<br>to spindle nose . . . . . | 36½"               |
| Height . . . . .   | 20½"               |
| Radial clearance above apron . . . . .                   | 9"                 |
| Spindle hole diameter . . . . .                          | 2½"                |
| Approximate shipping weight . . . . .                    | 550 pounds         |
| Net weight . . . . .                                     | Approx. 400 pounds |

**STANDARD EQUIPMENT**

- Variable speed pulley assembly
- Two face plates
- One collet draw-in bar
- One twelve-fire single jet adjustable oxygen-gas or oxygen-hydrogen burner
- Hand carburetion control
- Foot pedal control of air or nitrogen supply and of oxygen-gas volume
- Main air valve controlling air in either or both spindles
- 1/4 h.p. Motor, 110 volt, single phase, single speed, 60 cycle, AC
- Face plate wrench
- Two motor belts
- One motor pulley

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That simple chucking attachments supply versatility for wide varieties of applications?

That special chucking for your industrial procedures, or laboratory practices are available?

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**IF YOU WILL LET US KNOW:** The Product You Are Filtering—Type of Equipment You Operate—Plate and Frame Or Rotary Filter—Whether Acid or Alkaline Solution—Temperature—Pressure—WE WILL MAKE SOME SUGGESTIONS.

Over 40 different cotton weaves, including filter twills, chain cloths, and filter flannels. We also recommend that you try our synthetic fabrics made of nylon, orlon, dynel, polyethylene, dacron, screen, etc. for acid and alkaline solutions.

Cotton, flax and synthetic fabrics are furnished by the yard or roll or cut and fabricated to meet your special requirements. Write for samples. Woven Glass Cloth For Highest Temperatures Dust Collector Bags and Tubes. Please state your specifications and we will submit samples promptly.

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## **CONTROL OF PRODUCT PURITY can be constant with MULTI-WASH DUST, FUME AND VAPOR COLLECTOR**

Processing of fine chemicals demands efficient control of air to keep contaminants out of the product and to maintain high quality and purity.

Effective dust control equipment prevents the contamination of one product from dust from other processes. Recirculation and reuse of water keep costs low.

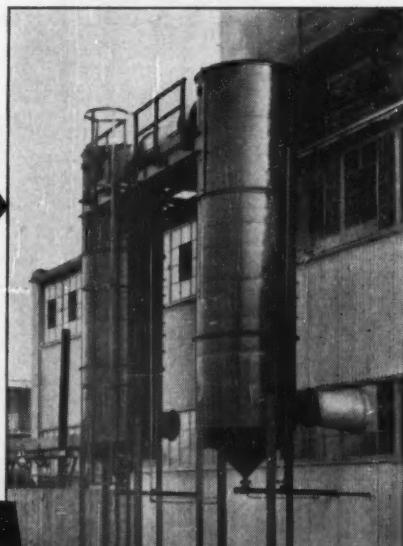
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If you have a chemical dust, fume, vapor or odor problem be sure to call in a Schneible representative or call direct, collect.

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Cable Address for Foreign Inquiries: CBSCO

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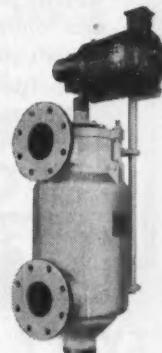
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## **Protect your process streams with MERCO STRAINERS**

Merco strainers provide efficient, continuous screening of oversized particles for tramp materials from liquid or slurry process streams. They guard against unforeseen plant stoppages or possible injury to expensive process equipment.

### **• For high throughput ...**

the Merco Standard Rotary Strainer. For capacities to 400 GPM. Assures continuous flow of liquid and sized particles free from coarse materials.



### **• For limited throughput ...**



the Merco Bantam Rotary Strainer. For capacities to 50 GPM. This compact unit delivers the same trouble-free, continuous service as the Standard model.

**Where particle size is  
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Write for full information  
on either of the above units.

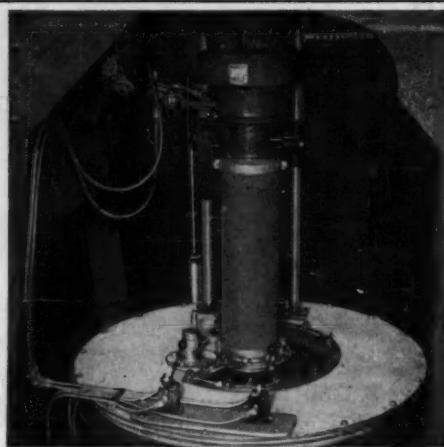
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The latest Fletcher development in its line of modern high-speed centrifugals is the use of pneumatic controls to greatly ease and simplify unloading operation. By this means the back-breaking and fatiguing hand cranking operation is eliminated, and the operator's efficiency is materially increased. The scraper is at all times under complete control.

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Fully automatic, this precision machine maintains accuracy down to one-half gram, with free-flowing materials, and speeds your production at the rate of 25 weighments per minute. It's flexible, too. Model shown has a range of weighments from one ounce to ten pounds. If unit is mounted on casters, it can operate from several hoppers. Visual indicator provides constant check and speeds setting up production or changing to a new weight. Write for complete details.

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**Burning Issues**

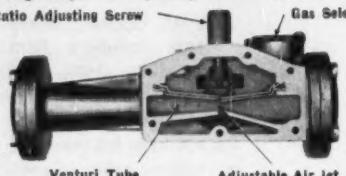
Eclipse

Published by Eclipse Fuel Engineering Co.  
Rockford, Illinois

**Announcing new, larger  
Eclipse Vari-Set Proportional  
Mixers for more efficient  
process heating**

Now available in pipe sizes up to and including 3", the new Eclipse Vari-Set Mixer puts perfect proportioning within easy range of most batch and process heating jobs. With built-in adjustable jet, it eliminates costly equipment changes to get correct air-gas mixtures. Permits you to change capacities quickly and easily and com-

Ratio Adjusting Screw

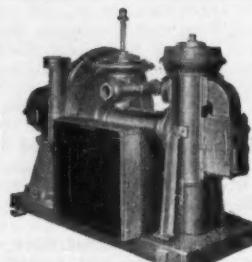


pensate for incorrect burner sizing, piping losses, etc. without dismantling mixers, pipes, or burners. Gives you various volumes of perfectly proportioned low-pressure gas and air for true combustion efficiency.

The gas selector (left) easily adapts the mixer to your particular gas fuel. The ratio adjusting screw (below) varies the jet area by fine increments to produce the exact air-gas ratio needed.

And, the air control valve provides a visual setting, with high and low limits, for controlling air to the Vari-Set assembly in line with burner limitations. Ask for a demonstration . . . and prove to yourself that this latest mixer development can eliminate vexing combustion problems and reduce heating costs.

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For central mixing, Eclipse Diluters give you precise air-gas ratio control, fingertip ratio adjustments, wide turndown range, dependable operation, and wide selection of delivery pressures and capacities. For large jobs—Deliver up to 140,000 CFH; Eclipse Oscillating Proportioning Valves for small and medium jobs—up to 6000 CFH.

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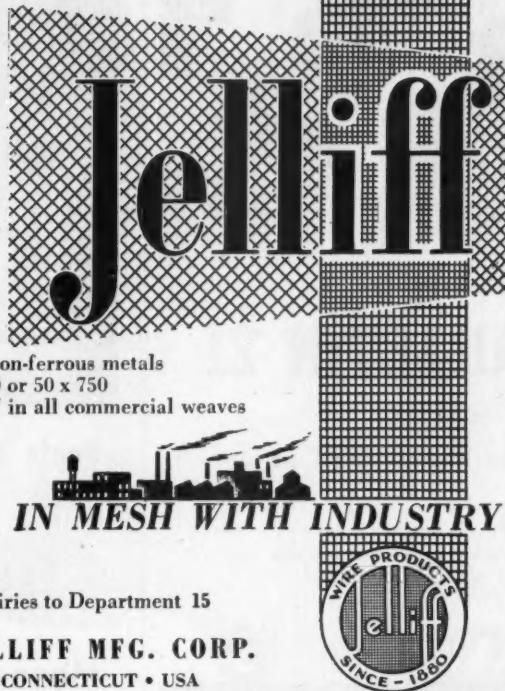
Write for Bulletin "L" describing the complete line of Eclipse air-gas Proportional Mixers—the "heart" of any combustion system!

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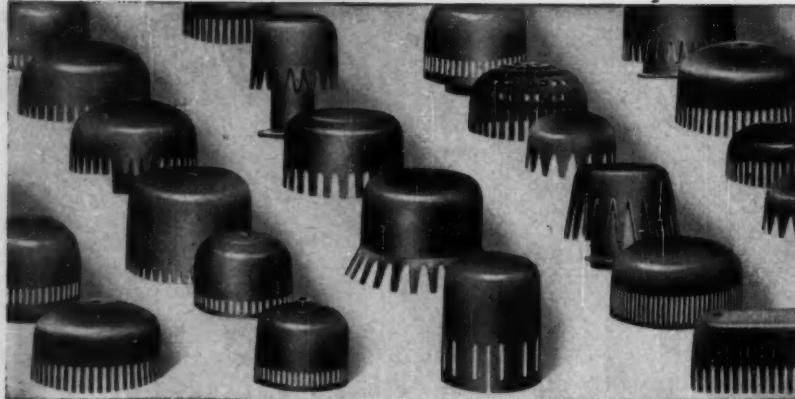
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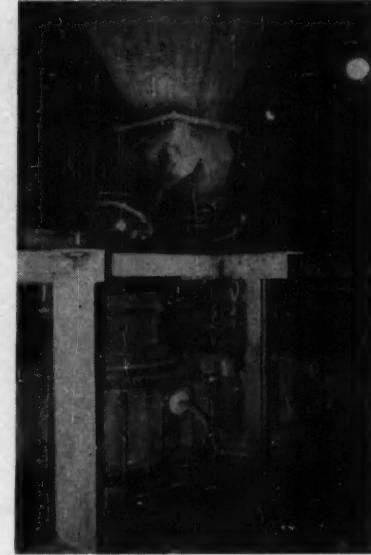
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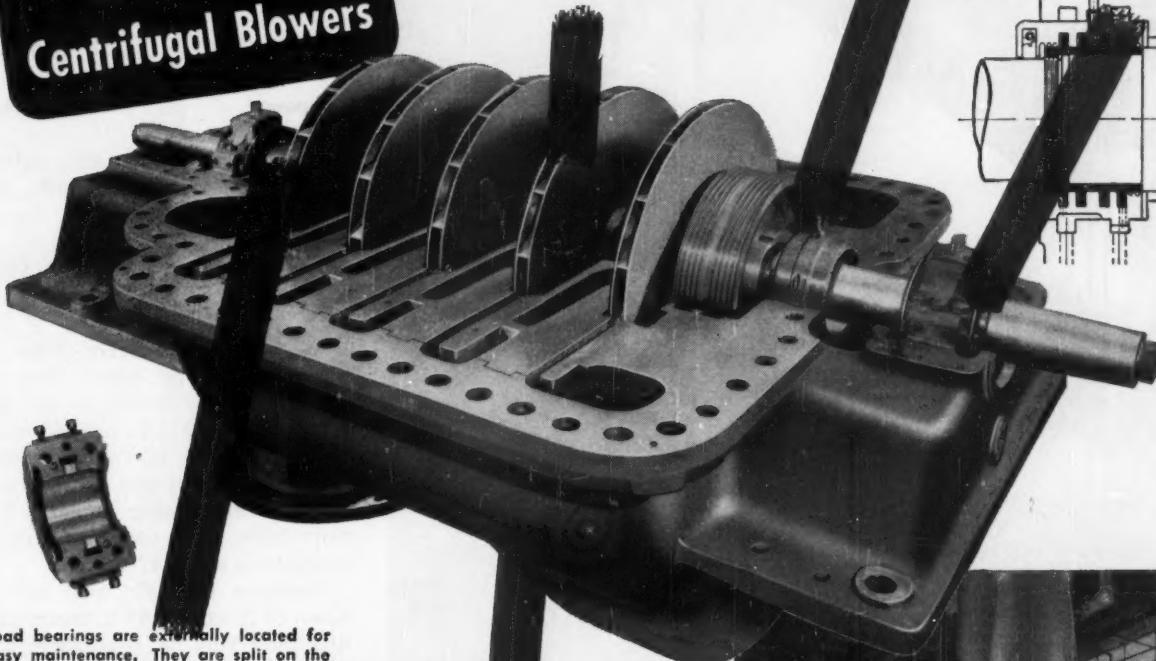
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**Centrifugal Blowers**

Impeller construction provides unobstructed passage of air or gas. Impellers are furnished in riveted or welded types, as determined by impeller dimension. Note that in riveted impeller wheels, rivets are integral with, and milled from, blade stock.

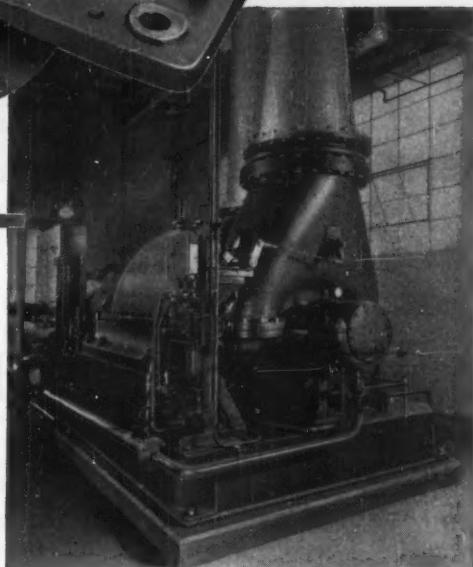
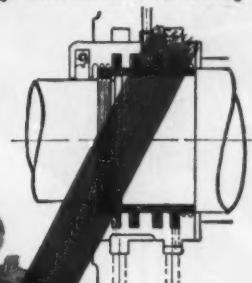


Load bearings are externally located for easy maintenance. They are split on the horizontal centerline for easy rotor removal. They consist of a cast-iron shell with removable, babbitt-lined steel inserts.

Casing is heavy cast iron, alloy, or forged steel.

Impeller wheels are located accurately on shaft with sleeves and are mounted with light shrink fit. Bores are ground to size. Lock nuts prevent axial movement.

Sealing during operation is provided by oil pressure seals. A carbon ring seal prevents leakage when blower is not running.



## Why these blowers can run for years without stopping

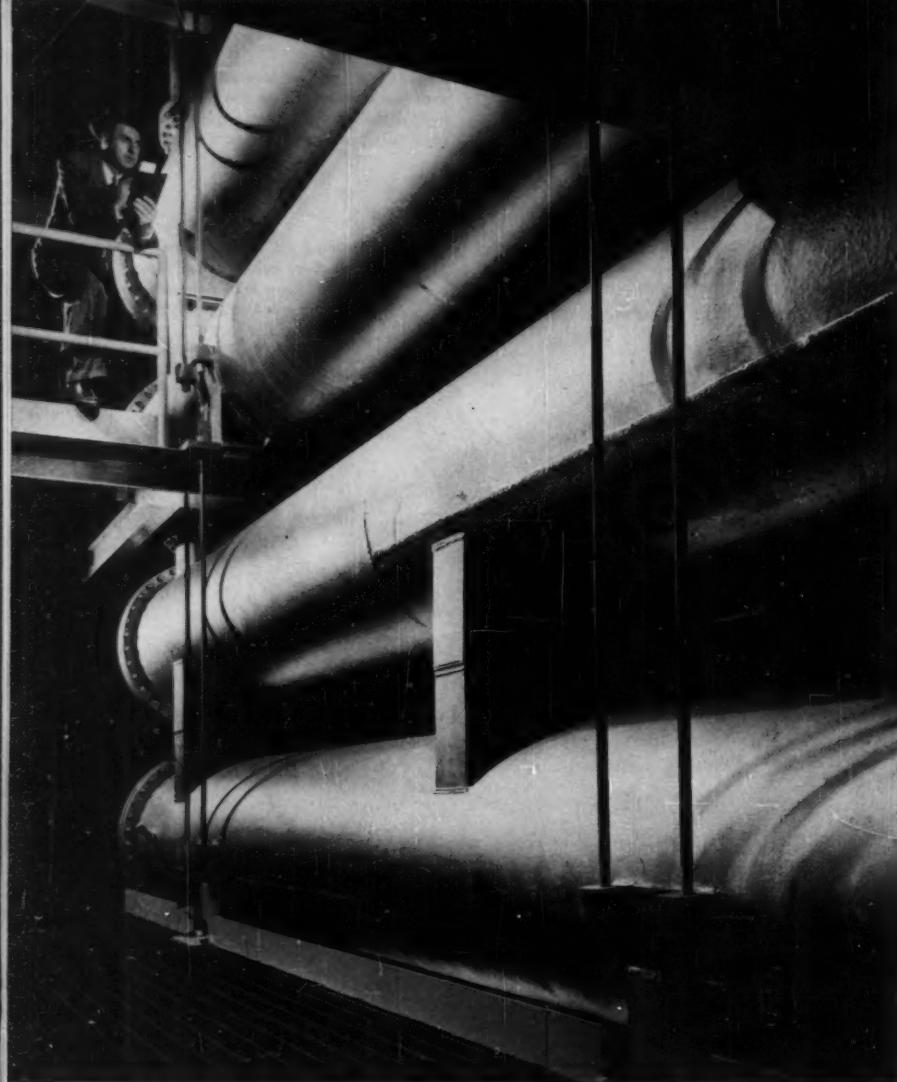
The key to "round the clock" performance of blowers in chemical plants is *quality*, as illustrated in the features above.

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This Allis-Chalmers four-stage centrifugal blower supplies 24,000 cfm to the catalytic cracking tower of an eastern refinery on a 24-hour-a-day basis, month in and month out.

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DIGESTERS—key equipment in this process for making . . .

## Semi-Chemical Pulp . . .

**Continuously and fast. And screw-press washing, automatic controls, are other important features of this modern pulp mill.**

**T**O CONVERT chips to paper in less than one hour, with a yield of 80%, American Box Board's new semi-chemical pulp mill\* uses the latest word in continuous digestion and washing equipment.

Continuously turning out 350 tons per day of pulp from aspen wood, the mill is the largest of its type in the U. S., and a good example of the trend

toward continuous automatic processing in the pulp and paper industry.

Located at Filer City, Mich., it uses a neutral sulfite solution to make pulp—and this pulp is later converted to 0.009 in. corrugating medium for box board.

► **How the Process Works**—Aspen logs are debarked with steam, then chipped. These chips are screened and weighed into bins.

Sulfur is melted, and oxidized to sulfur dioxide. It's then absorbed in a soda ash solution, forming a neutral

\*Semi-chemical pulping differs from sulfite or sulfate processes in that semi-chemical cooking removes only a small amount of the cementing material in the wood. Mechanical disintegration must therefore be used, in addition to digestion.

### Process Requirements, Per Day

|             |             |
|-------------|-------------|
| Soda ash    | 140,000 lb. |
| Sulfur      | 19,000 lb.  |
| Steam       | 2,100 lb.   |
| Electricity | 11,000 kva. |
| Manpower    | 2 men       |

sodium sulfite solution. After sodium bicarbonate is added as a buffer, the liquor is fed to continuous Pandia Chemi-pulpers.

These are two six-tube units. Each tube is 36-in. in dia., 21-ft long, and has a 16-in. dia. feed screw.

In the digesters, sulfite liquor is sprayed on chips (which feed in through a screw feeder) in the first tube. Steam at 373 F. and 165 psi. is introduced at the inlet of the second tube. Chips and liquor are then conveyed under pressure through four more tubes. This cooking process is complete in about 12 minutes.

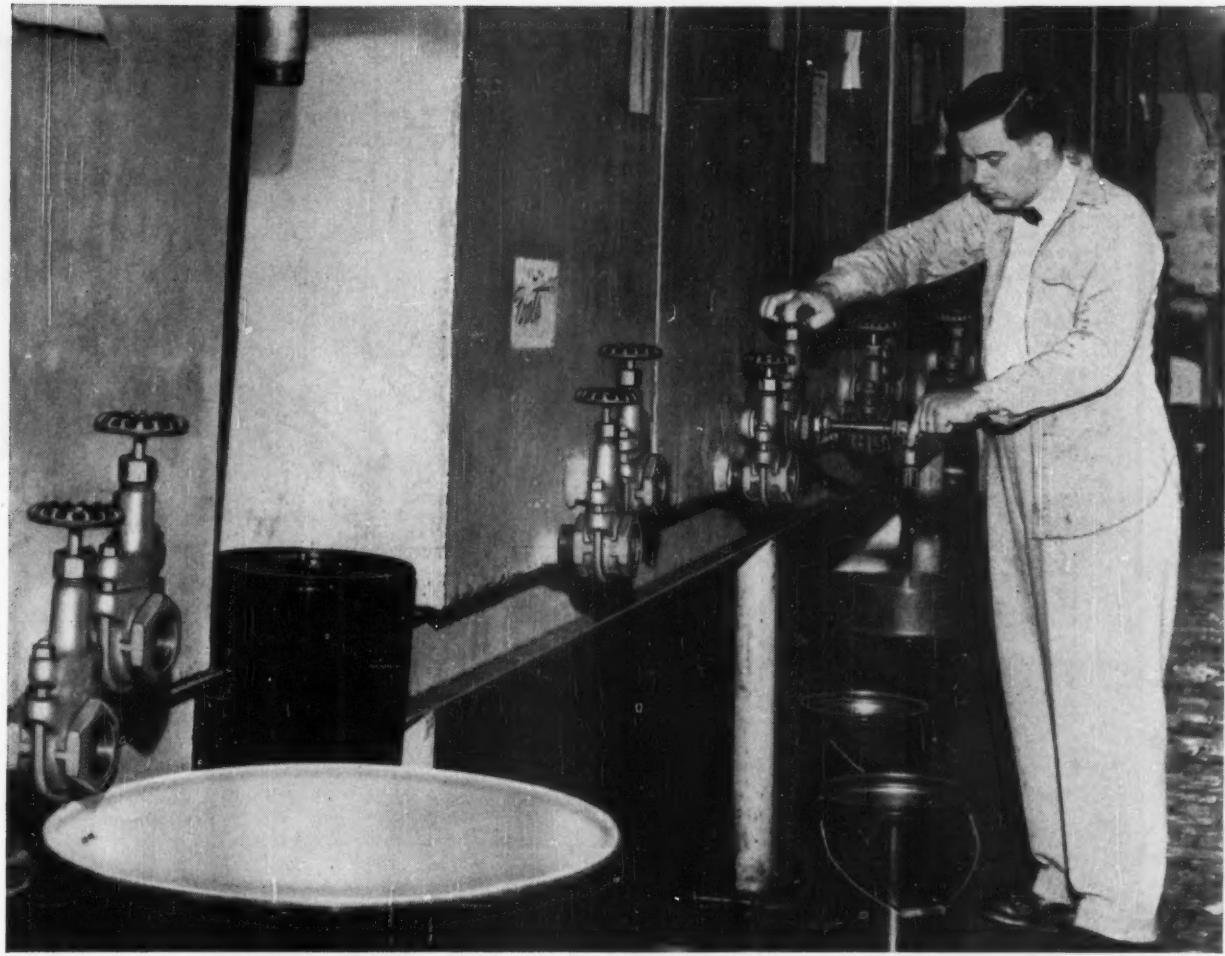
Discharge from the final tube is blown 65 ft. up and 45 ft. horizontally to a blow tank. A continuous blow orifice-valve handles this, eliminating the usual large jet steam condensers and large blow tanks usually found in pulp mills.

► **Refining the Pulp**—Two screw conveyors take a 25-30% chip consistency material to disk refiners. Cooked chips are converted to pulp by the shredding and separation action of the refiners. Strong sulfite liquor is added at this point—reducing the consistency to 15%. The pulp then passes to a surge bin, and drops onto a conveyor which feeds the screw press washers.

► **Washing the Pulp**—Each stage of the four-stage washer contains a shaft fitted with screw flights. The shaft diameter increases toward the discharge end of the stage, while the pitch of the screw decreases. This produces horizontal as well as vertical compression.

A 12% pulp goes to the first stage, where it's squeezed down to 36%. In the second stage, it's slurried with weak liquor to 12%, and compressed to 36%. Discharge from the fourth stage is adjusted to 18% and sent to high density storage.

Pulp is prepared for the paper machine by treatment in standard jordan machines.



## Leakage troubles here stopped by these CRANE VALVES

**THE CASE HISTORY**—Read why Hysan Products Co., Chicago, changed to Crane Clamp Gate Valves in all process and storage piping. Hysan makes liquid waxes, pine oil and coal tar disinfectants, liquid soaps, and similar chemical specialties.

Valves formerly used were similar to Crane Clamp Gates, but only in appearance. They lasted no more than 2 to 6 months—leaking at seats and disc with no more than 3 to 12 operating cycles daily. Maintenance and replacement costs mounted—as did down-time losses. The leaky valves on tank lines forced repeated transfer of storage stocks. As many as 3 men were needed to make valve repairs.

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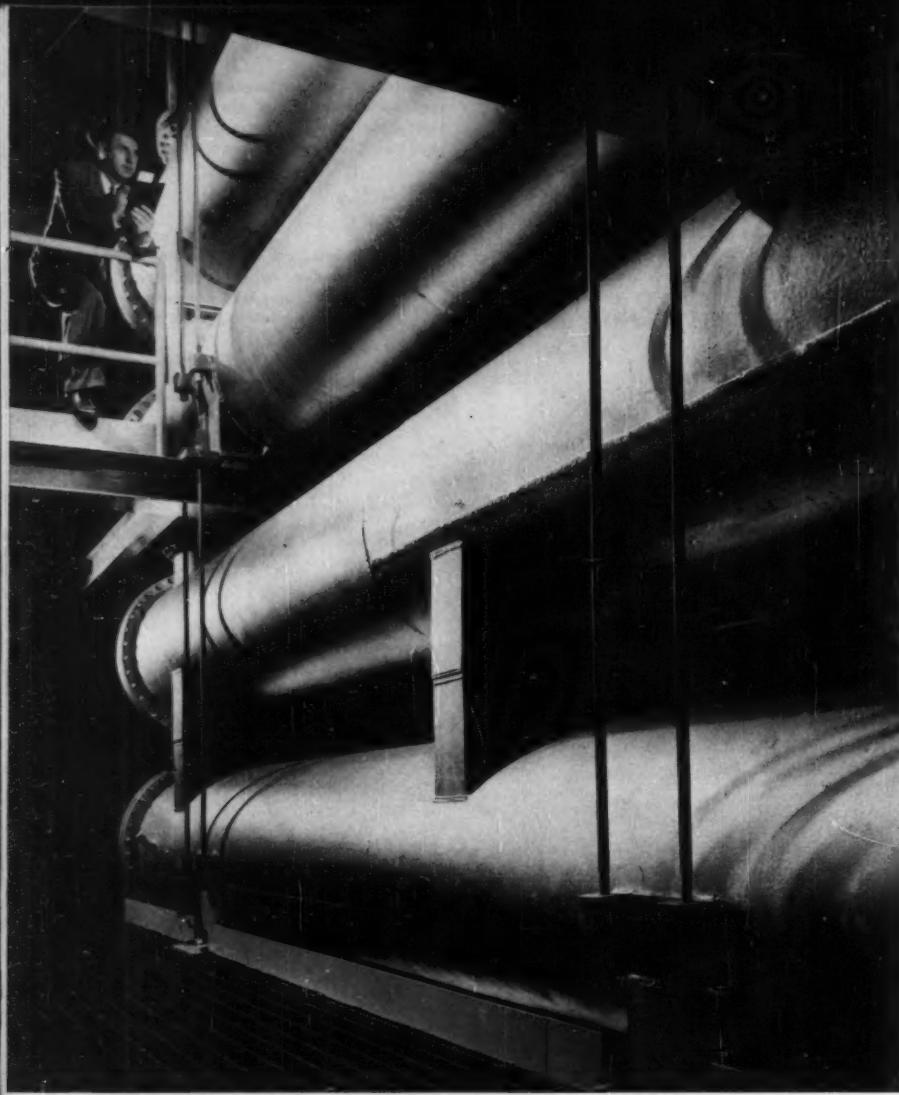


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**DIGESTERS—key equipment in this process for making . . .**

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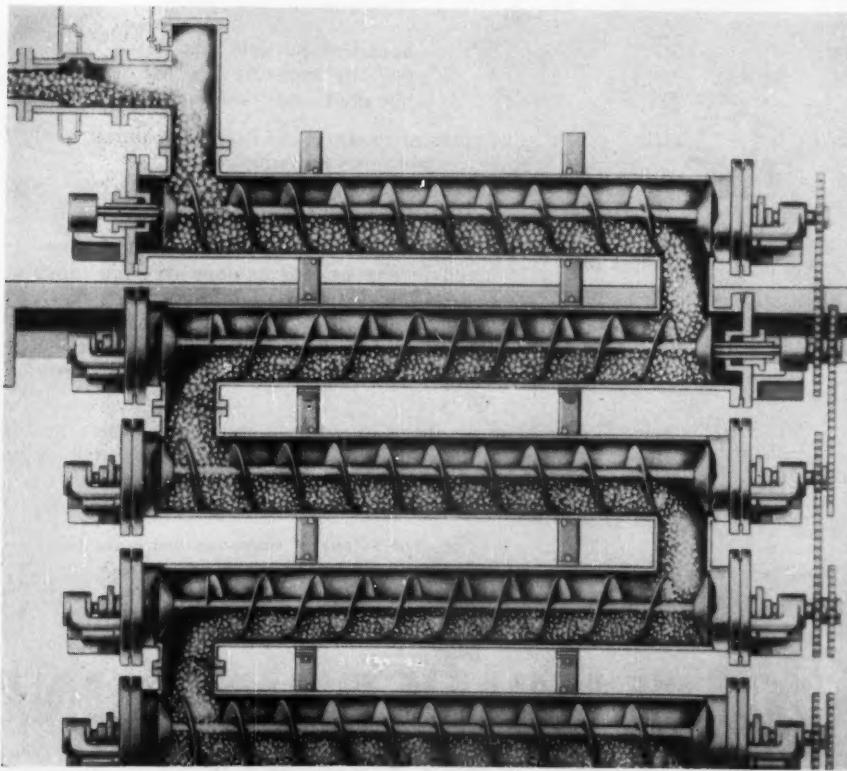
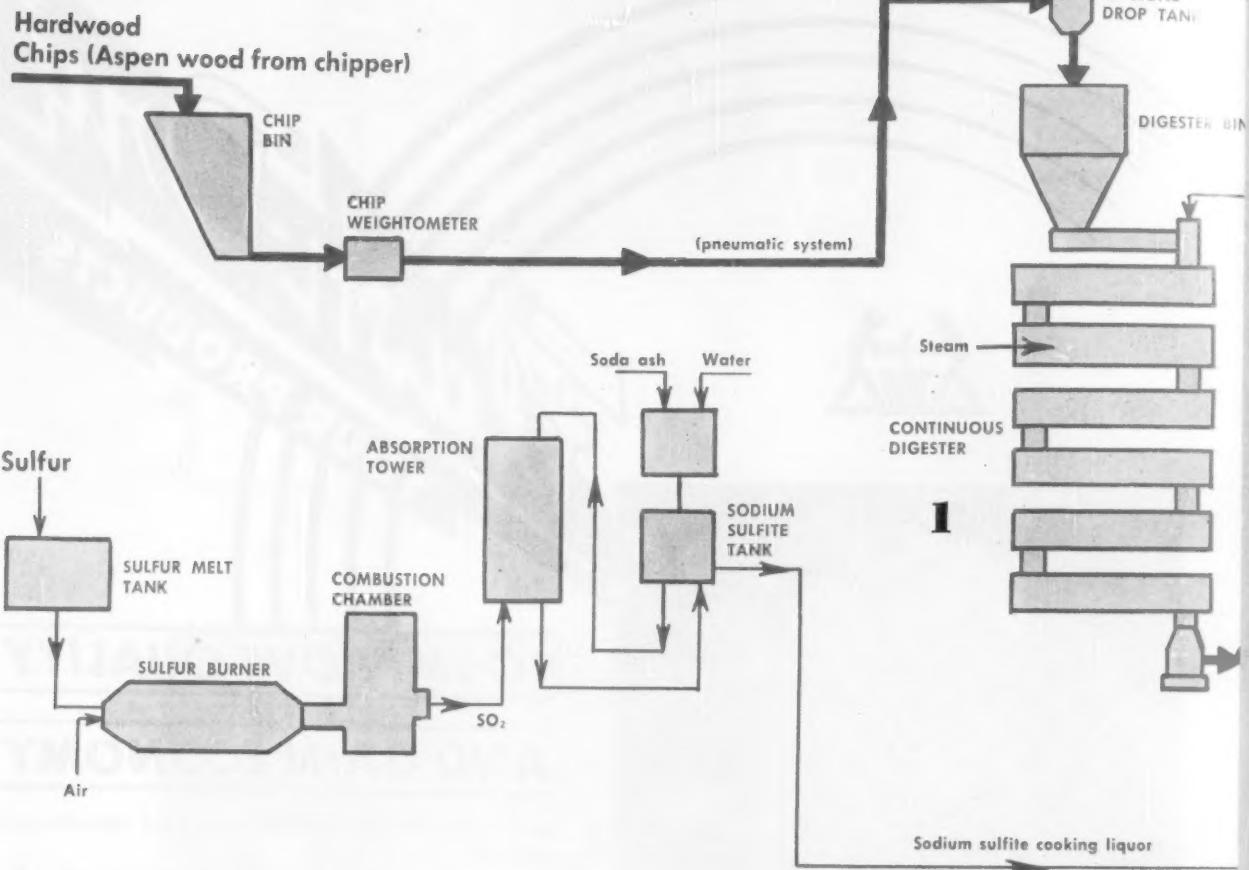
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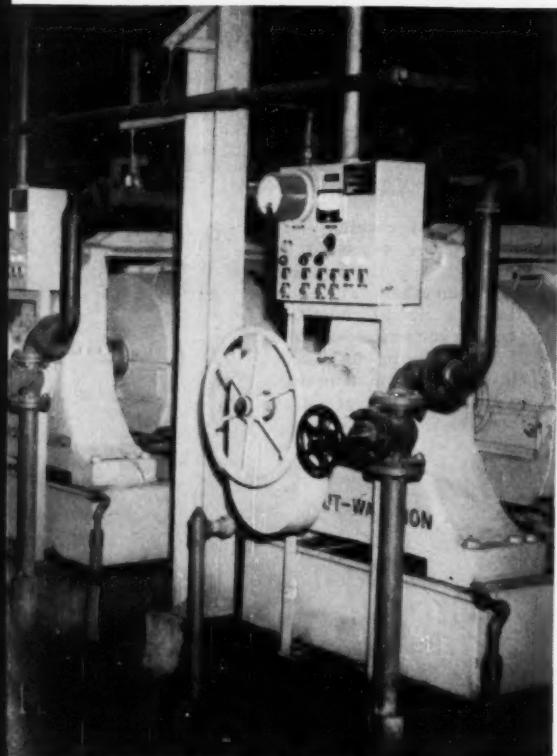
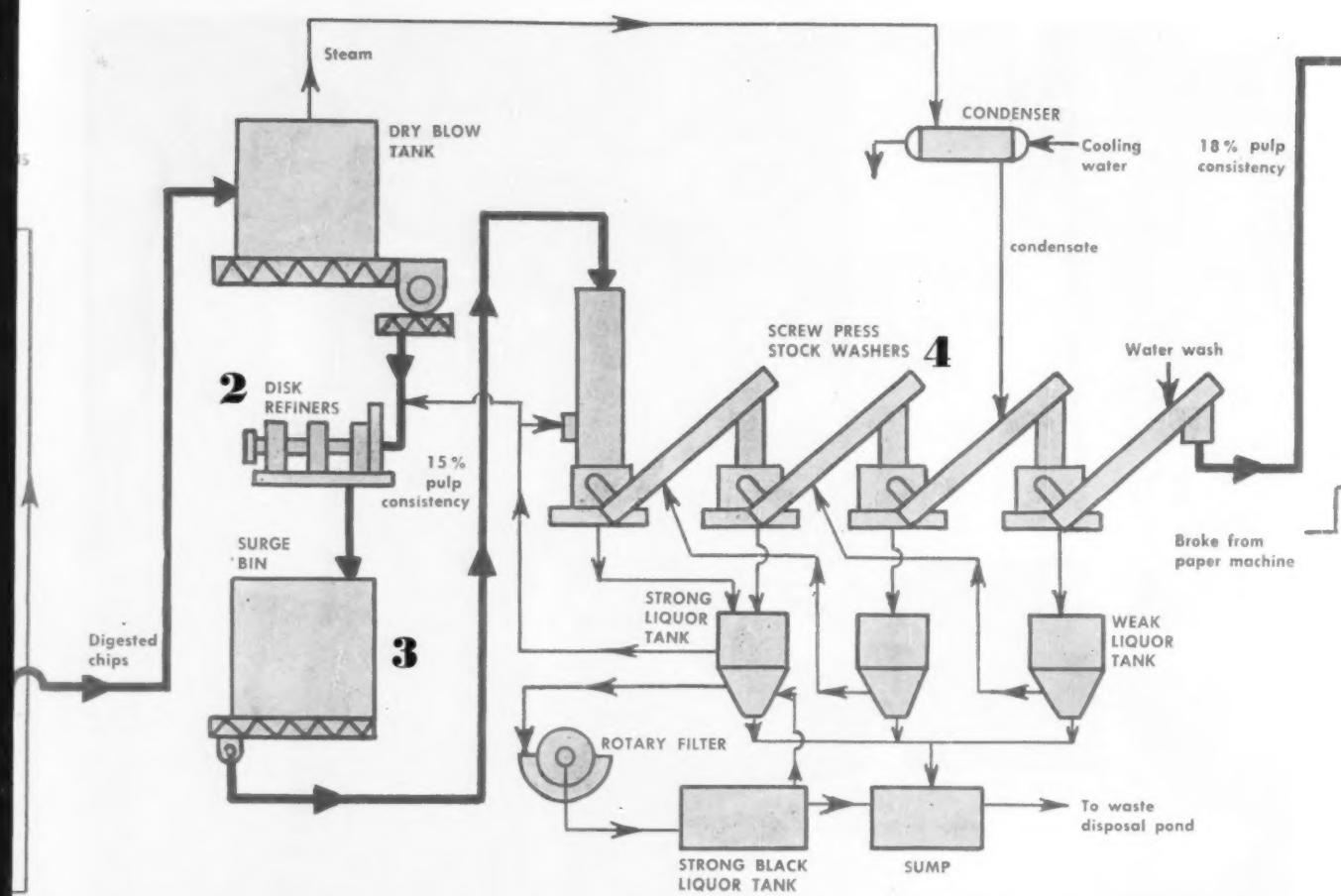
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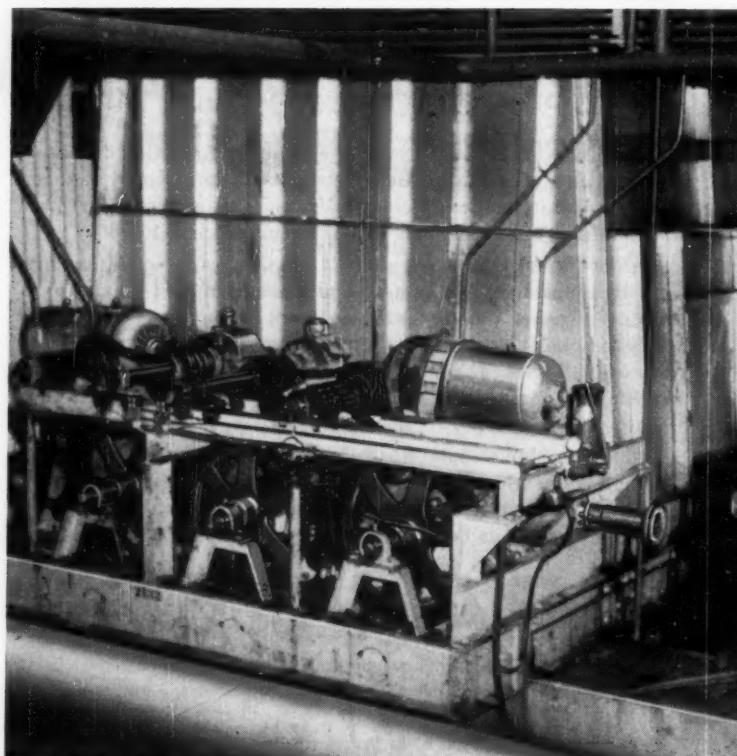
1 CONTINUOUS DIGESTER, where aspen chips, sulfite liquor and steam are brought together. The hold-up time here is about 12 minutes.



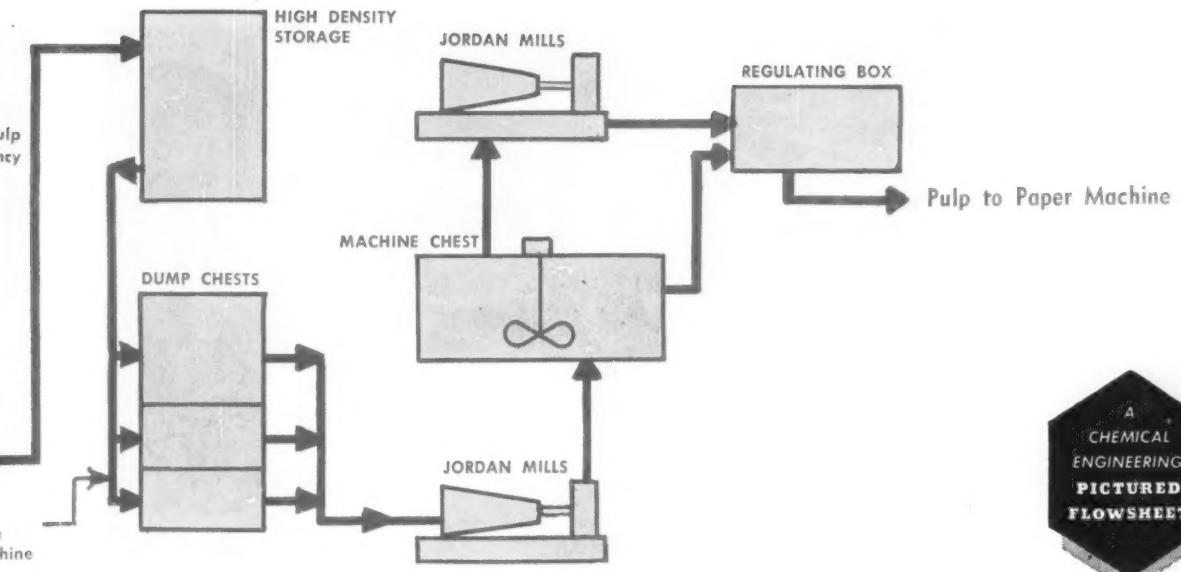
2 DISK REFINERS. Here of the disks, forming a pa



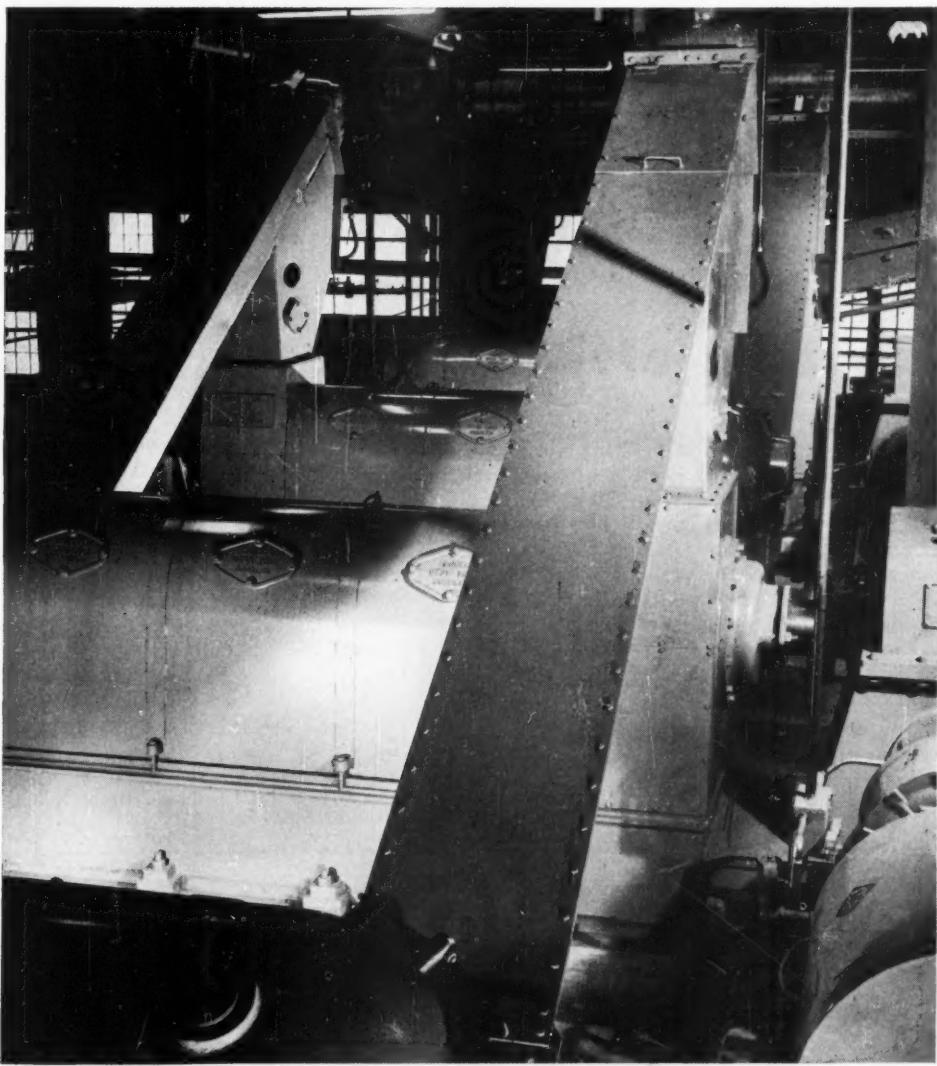
the digested chips are shredded and separated by the action of the disk refiners and the screw washers.



3 SURGE BIN, showing the 12-screw conveyor live bottom. The screw washers reduce the pulp to a 15% consistency.

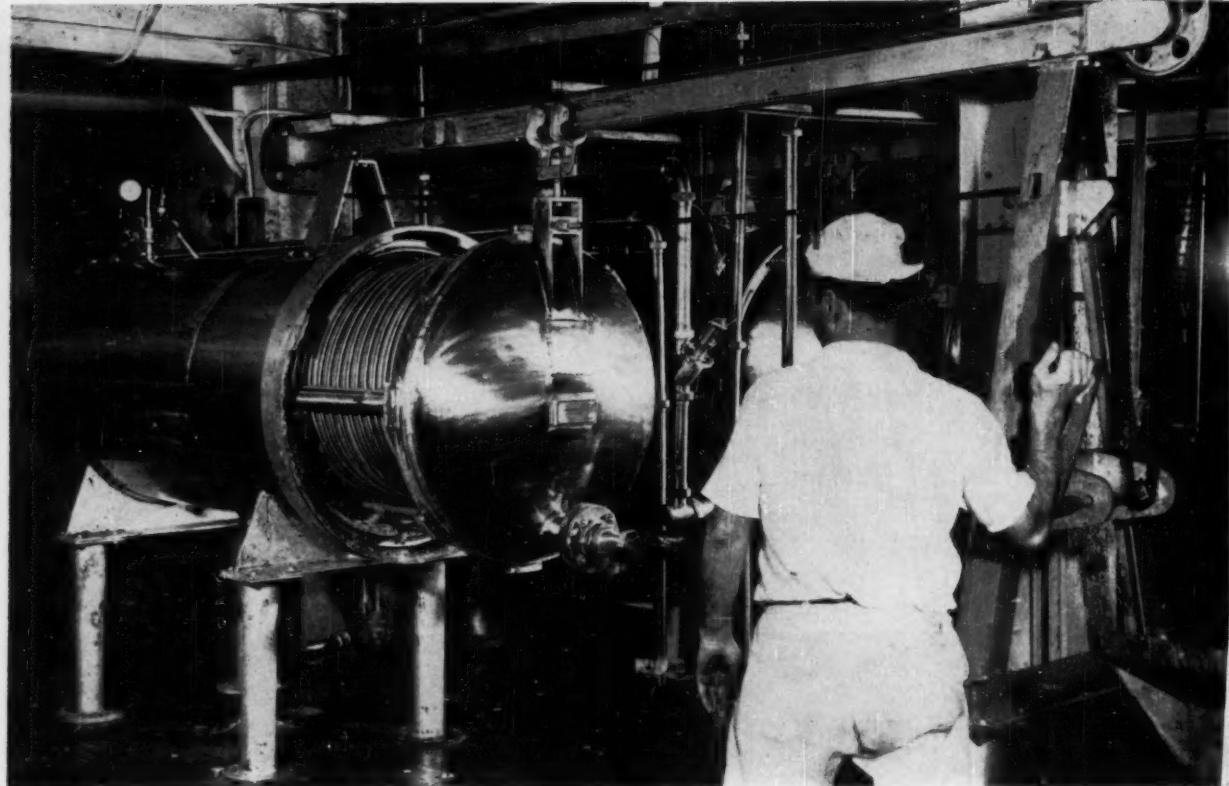


A  
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e screw conveyor brings

**4** CONTINUOUS SCREW PRESS WASHERS, with four stages shown. Each stage concentrates the pulp by screw compression, after a slurry has been formed with wash waters.



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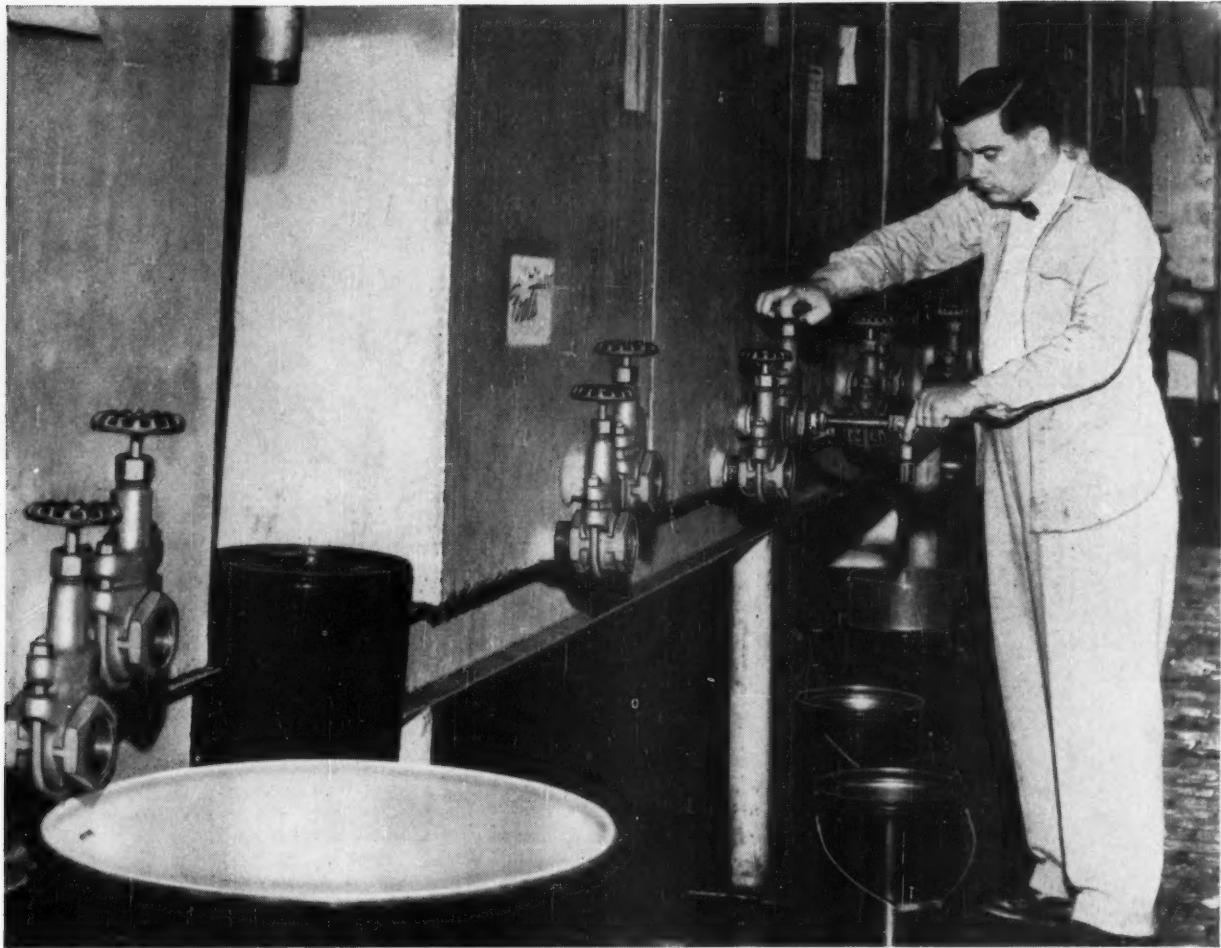
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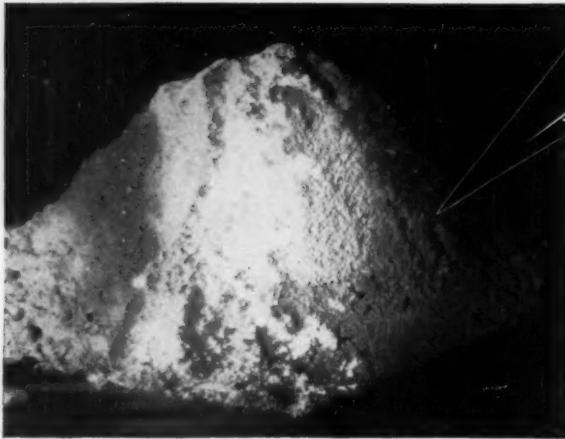


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Here is an example of today's top-level manufacturing efficiency:

With a *single pass* of the raw material through a Raymond Imp Mill Flash Drying System, you can get a finished end-product of

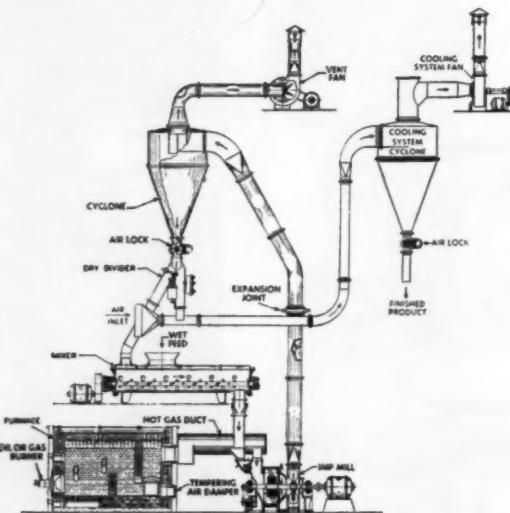
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Chemicals, pigments, foods, industrial wastes, synthetic resins, filter-press products and a wide range of powdered materials can be handled at proven lower costs by Raymond Flash Drying. It will pay you to investigate.

*For details of operation and typical applications of Raymond Flash Drying, write for Catalog No. 54-A.*



Typical flow sheet of Raymond Imp Mill with Flash Drying and Cooling System.

# **COMBUSTION ENGINEERING, INC.**

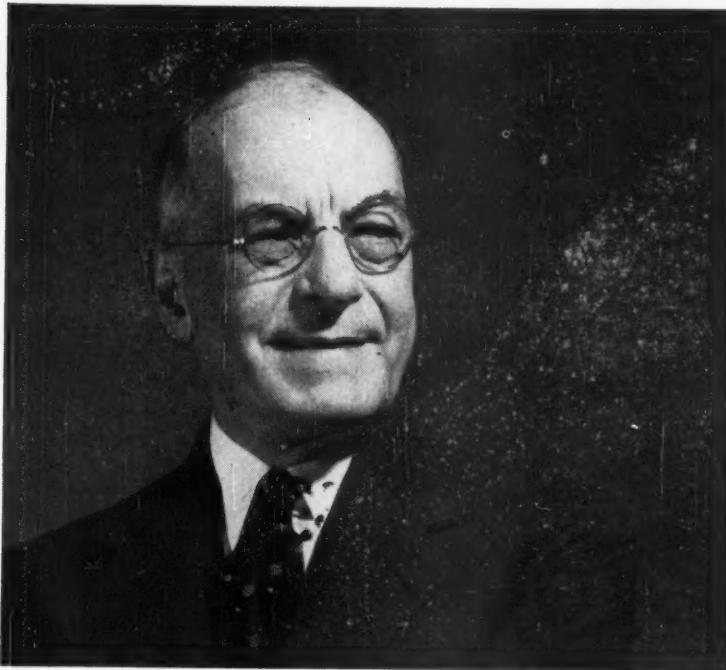
*Raymond Division*

1311 North Branch St.  
Chicago 22, Illinois

Sales Offices in  
Principal Cities

# Names in the News

*Edited by R. K. Citlin*



MAN OF THE MONTH

## Roger Williams: Perkin Medalist

**Du Pont man honored for his outstanding contributions to industrial chemistry.**

This month, the 49th impression of the Perkin Medal, annual award of the American Section of the Society of the Chemical Industry, will be presented to Roger Williams of Du Pont.

Currently vice president and member of both the board of directors and the executive committee of Du Pont, Mr. Williams is being honored for a lifetime of notable accomplishments in many phases of applied chemistry. Included in these achievements are important contributions to the development of processes for synthetic ammonia, ethylene glycol, methanol, methyl methacrylate and to the war-time atomic energy program.

When Roger Williams first came to Du Pont in 1918, fresh from two years of graduate work at MIT,

his alma mater, and two years as a research chemist with Nitrogen Products Co., Du Pont was about to launch a post-war expansion and diversification program destined to change it from a relatively small, specialized manufacturer to the country's largest chemical company.

► **Start in Research**—In six years as a research chemist and research supervisor at Du Pont's Wilmington experimental station, Roger worked on a variety of research projects. Most important was a study of nitrogen fixation. Results of this study helped guide the company's decision to acquire rights to the Claude process for the direct synthesis of  $\text{NH}_3$  from its elements.

To exploit the Claude process, Lazote, Inc., was formed and Roger was made chemical director of the

new company. Almost immediately, he initiated research on the synthesis of methanol from  $\text{CO}$  and  $\text{H}_2$ . The project was so successful that manufacture of methanol was begun in 1926, only a few months after the first synthetic ammonia was produced.

► **On to High Pressures**—Close on the heels of this development came processes for the manufacture of higher alcohols (up to six carbon atoms), using the same raw materials and very much the same high pressure technique.

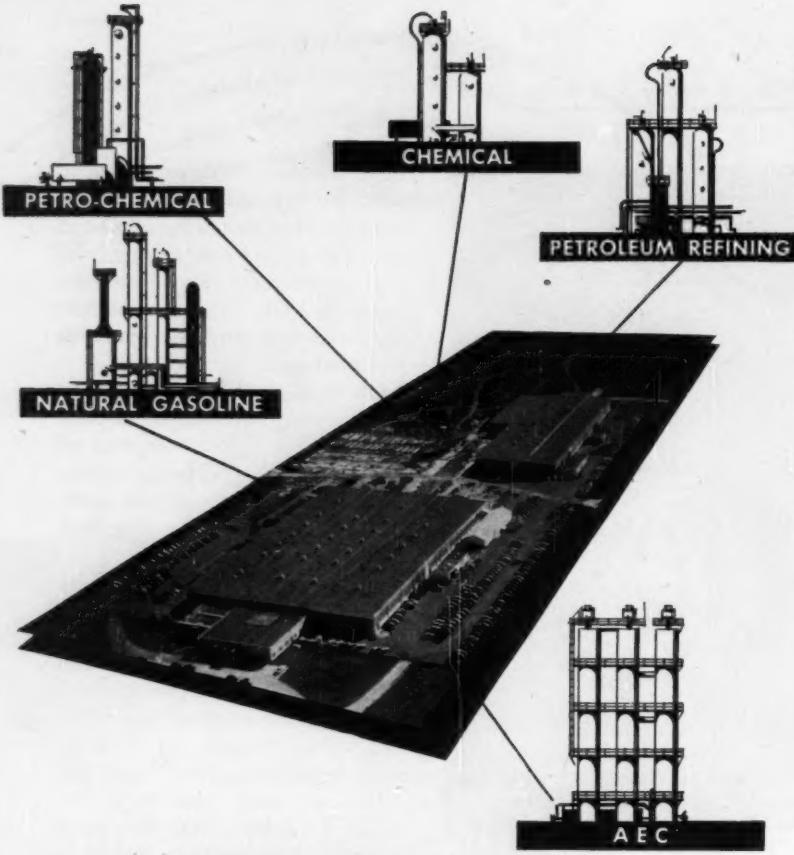
Other important research projects involving high pressure synthesis which were carried to successful conclusions under Mr. Williams' aegis were: Non-catalytic synthesis of urea from ammonia and  $\text{CO}_2$ ; production of acetic and propionic acids from  $\text{CO}$  and methanol, and  $\text{CO}$  and ethanol, respectively; synthesis of ethylene glycol from intermediates derivable from coal.

He also directed research on the synthesis of methyl methacrylate, and the development of a satisfactory process for making polyethylene as well as on processes for making nylon intermediates.

► **Built Plutonium Plant**—All this was but prelude to his biggest job. When Du Pont undertook to design and construct, without waiting for pilot plant results, and to operate the large plutonium plant at Hanford, Wash., for the government, Williams was given full responsibility for directing the program. For the substantial part which he played in this program, the government awarded him its Medal of Merit.

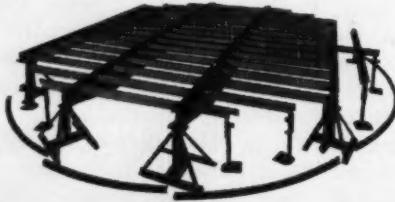
In 1945, following the successful completion of the atomic energy project, he was elected a vice president, director and member of the executive committee of the Du Pont Co. The positions he now holds.

From these posts he helps administer the day-to-day affairs of the company and also serves as advisor to all of the company's research and development groups. He has played a major role in shaping



## GLITSCH "TRUSS-TYPE" BUBBLE TRAYS SERVE ALL PROCESSING PLANTS . . .

Here at GLITSCH tray size, process layout, type of flow, type and shape of downcomer, weirs, and size and shape of bubble caps as well as suitable corrosion resistant material are not bound to standard patterns. In collaboration with GLITSCH engineers, customers' management and engineering staffs can effect definite savings in initial designing while planning exact features desired.



### *Glitsch Service...*

This is the GLITSCH "Truss-Type" mechanical design which makes so many savings possible. Write or call for Bulletin No. 154.

GLITSCH sales offices are located at  
**New York • Chicago**  
**Cleveland • Houston**  
**Tulsa • Los Angeles**



### NAMES . . .

Du Pont's post-war expansion in research facilities.

► **Sincerity and Modesty**—As you can imagine from this imposing list of accomplishments, Mr. Williams is a tremendously hard worker. Co-workers report that he literally pours himself into his many tasks.

This hard work, coupled with a near-legendary sincerity and modesty, has inspired the loyalty of a large group of Du Pont engineers—including some of the brightest names in the profession.

Along with the honors he has received and the respect he has gained, Mr. Williams has derived a great deal of personal satisfaction from the career of his son, Roger, Jr., who now heads his own consulting firm. He and his wife count among their most pleasant hours those spent with Roger, Jr., his wife and their two children.—HTS

**Ronald D. Gumbert**—Elected president and member of the board of directors, Alloy Precision Castings Co., Cleveland, Ohio.

**K. H. Rowland**—Assistant works manager of Carbide and Carbon Chemicals Co., New York, N. Y.

**Hugh S. Ferguson**—Vice President of W. R. Grace & Co. Mr. Ferguson heads the Dewey and Almy Chemical Co. division of Grace.

**William E. Dugan, Jr.**—Senior assistant plant manager of the chlorine-caustic soda chlorinated methane operations, Solvay Process Division, Allied Chemical & Dye Corp., Moundsville, W. Va. **Raymond C. Baxter** succeeds Mr. Dugan as assistant chief engineer of the division.

**Jean R. Okel**—Manager of project evaluation for the development department of Monsanto Chemical Co.'s research and engineering division.

**Bradlee V. B. Postell**—Assistant to Howard I. Cramer, vice president, development, Sharples Chemicals Inc.



William T. Nichols

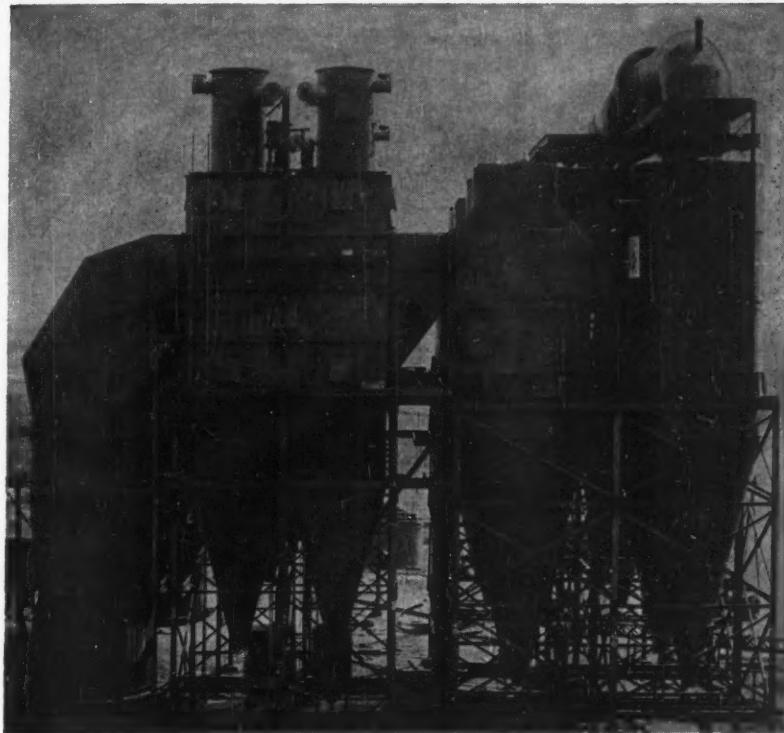
Mr. Nichols, a past president of the American Institute of Chemical Engineers, has joined Arthur D. Little, Inc. as a senior staff member. He has previously been associated with the Monsanto Chemical Co. (as director of general engineering department and later, assistant to the vice president for research and engineering) and the Westvaco Chemical Corp.

**Linus Pauling**—Awarded 1954 Nobel prize for chemistry. Dr. Pauling is chairman of the division of chemistry and chemical engineering at the California Institute of Technology, Pasadena, Calif.

**Thomas F. Edson**—Promoted to the newly-created post of vice president in charge of special engineering projects, American Potash & Chemical Corp. Richard J. Hefler, company secretary, goes into the new position of presidential assistant while Joseph C. Schumacher becomes director of research.

**H. B. Peters**—Chief engineer, refining department, The Texas Co., succeeding David W. Carswell who has retired after 37 years with Texaco.

**John A. Quinn**—First-prize winner of the 1954 student contest sponsored by the American Institute of Chemical Engineers. Mr. Quinn is now a graduate research assistant at Princeton University. John W. Klar, Purdue graduate



#### CARBON BLACK PROCESSING

## detail designed and fabricated by BOARDMAN OKLAHOMA CITY

This carbon black unit, shown during field erection, was fabricated many miles from the site; yet it assembled easily into a working unit. That's because BOARDMAN has had 44 years of experience in the type of detail designing and precision fabricating required for such results. During these years, every type of metalcrafting problem—both large and small—has been solved by BOARDMAN's metal fabricating "know-how". Make it your policy to consult BOARDMAN for all wrought iron, mild steel, stainless steel, clad steel and aluminum fabricating.

#### WE CHALLENGE YOU

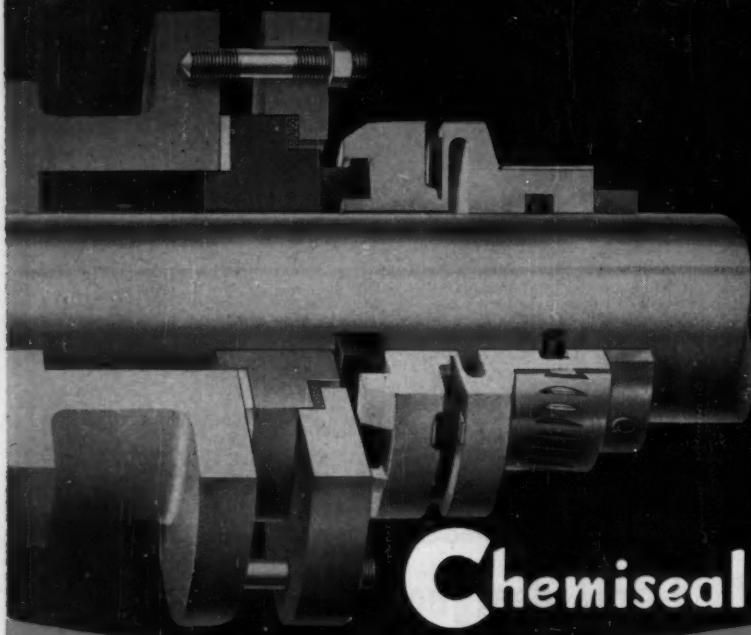
On your next metal fabricating job, ask our Chief Engineer to fly to your plant for on-the-spot consultation. There is no cost to you, and you're under no obligation. We want you to accept this challenge at our expense. Telephone COLLECT today—or write for our metal products catalog.

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PRESSURE VESSELS INCLUDING A.S.M.E. CODE VESSELS • BATCHERS • BINS • BURNERS  
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• STERILIZERS • TANKS • TRANSPORTS • WASHERS

# Here is the Shaft SEAL you have been wishing for



## Chemically Impervious TEFILON Balanced Bellows Design

Three years of actual field tests have proven that Chemiseal external mechanical seals last longer and give unsurpassed performance under a wide variety of chemical service conditions—handling acids, alcohols, alkalies, hydrocarbons, and related chemical compounds including abrasive slurries and tarry material (with provisions for flushing).

Combining the Bellows design, which provides pressure balance so essential for long leak free service, with duPont TEFILON the wonder plastic for immunity to corrosion and contamination—United States Gasket engineers have produced a mechanical seal which makes "sealing" simple and economical for the process industries.

### FEATURES

- CHEMICALLY IMPERVIOUS TEFILON Bellows section. A selection of seal face

*Write for Bulletin No. MS-954.*

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GASKET  
COMPANY

CAMDEN 1 • NEW JERSEY  
FABRICATORS OF duPont TEFILON,  
Kellogg KEL-F AND OTHER PLASTICS  
Representatives in Principal  
Cities Throughout the World



### NAMES . . .

school, was second-prize winner. Robert B. Grady, of the University of Minnesota, won third prize.

Fred C. T. Daniels—Retired November 1 as vice president of research and development for Mackintosh-Hemphill Co., Pittsburgh, Pa.



Gustav Egloff

Dr. Egloff, director of research and development for Universal Oil Products Co., was awarded the Carl Engler Medal at Essen, Germany, on October 7. The award was presented by the Deutsche Gesellschaft Fur Mineralölwissenschaft Und Kohlechemie E. V. (German Society for Mineral Oil Science and Coal Chemistry) in recognition of Dr. Egloff's outstanding contributions to the science and technology of oil refining. It was the first time the award was bestowed upon a foreigner.

L. G. Immonen—Plant manager of Western Electrochemical Co., Henderson, Nev., formerly with Kennecott Copper Corp. at McGill.

Alfred F. Fields—Retired after 42 years with General Electric Co., Pittsfield, Mass. Mr. Fields was a pioneer in plastics manufacturing.

G. D. Butterworth—Head engineer, project engineering, in Standard Oil Co.'s general engineering department, recently established in Whiting, Ind.



*Fabian Bachrach*

**Robert H. Dodd**

Dr. Dodd, designer and builder of oil refineries throughout the world, has been appointed head of chemical engineering at the Oklahoma Institute of Technology, A. & M.'s engineering school. Prior to his appointment at A. & M., he was associated with Shell Oil Co., Standard Oil Development Co., Gulf Oil Corp. and—most recently—with The Lummus Co.

**Elmer H. Weaver**—Vice president of Union Oil Co. of California, Los Angeles, Calif.

**George R. Keenan**—Staff engineer, General Foods' central laboratories, Hoboken, N. J.

**Alex G. Oblad**—Chairman-elect of the Petroleum Chemical Division, American Chemical Society. Dr. Oblad is associate manager of the research and development division, Houdry Process Corp., Marcus Hook, Pa.

**Charles B. Henderson**—Staff member, engineering division, Atlantic Research Corp., Alexandria, Va. Mr. Henderson will work on solid propellant combustion projects.

**H. E. Hughes**—Appointed to new post of assistant superintendent-technical, Shell Chemical Corp.'s Houston, Tex. plant.

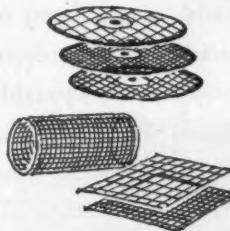
**John A. Sullivan**—President of Tuttle & Kift, Inc., Chicago,

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may be in stock at  
**CAMBRIDGE**



Supplies of many of the most frequently used types of industrial wire cloth are kept in our warehouse ready for immediate shipment to you. And even if the type you use is not in stock, we can schedule our looms to have your material in your plant without delay. Any metal or alloy; sizes range from 20 x 250 mesh up to 4" openings...and accurate mesh count is our pride.

## also **FABRICATED PARTS**



Filter leaves, strainers, sizing screens, etc. We can fabricate most any type of part you need, in any quantity. We'll work from your own prints or, if none are available, our Engineering Department will draw up prints from your description of what the part must do. Once you've O.K.'d them, we'll start production.

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WHERE HEAT AND  
CHEMICAL CONDITIONS  
ARE EXTREME

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**STAINLESS STEEL**

GRATING AND STAIR TREADS

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KERRIGAN SERVICE TO INDUSTRY**

STAINLESS STEEL Grating and Stair Treads — new boon to industries where grating must withstand acids and corrosion! KERRIGAN Weldforged Grating — one-piece, inseparable units, made in all types A.I.S.I. and S.A.E. Standard Stainless and heat-resisting steels and electronically resistance welded to stand up under the severest kind of punishment AND FABRICATED TO BE FREE OF ANY "ACID-TRAP" RIVETS OR NOTCHES!

Kerrigan also offers you a complete *custom* service: shop drawings are sent for your approval and grating is fabricated to your exact specifications (with finished grating match-marked for easy installation). Let us send you detailed information. We shall welcome your inquiries on this new Stainless Steel Grating.

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**NAMES . . .**

Ill. Ferrod Manufacturing Co., Batavia, Ill., Ferro Electric Products, Inc., Kirkland, Ill. All three companies are wholly owned subsidiaries of the Ferro Corp.



Joseph R. Mares

After completing 25 years of service with Monsanto Chemical Co., Joseph R. Mares of Dickinson, Texas, has launched an industrial chemical consulting practice specializing in petrochemicals and allied products. The former vice president and general manager of Monsanto's Texas City operations was director of the patent and development department at the company's headquarters in St. Louis before moving to Texas in 1947.

**Paul A. Manor**—Chief engineer of Rockwell Manufacturing Co.'s lubricated plug valve plant at Barberton, Ohio.

**John H. Gifford**—Technical director, carbon black division, Witco-Continental, Akron, Ohio.

**Robert D. Rice**—Manager of chemical engineering, Pittsburgh Coke & Chemical Co., Pittsburgh, Pa.

**E. Allan Morrow**—President of Roosevelt Oil & Refining Corp., succeeding John E. Bouldin, who resigned.

**Norman H. Parker**—Manager of engineering for the Turbo-Mixer Division of General American Transportation Corp., New York, N. Y.

**J. H. Salter**—General superintendent of the fertilizer division of Consolidated Mining and Smelting Co. at Trail, B. C., Canada.

**J. W. Healy**—Assistant superintendent, Standard Oil Co.'s research department laboratory at Wood River, Ill. **R. J. Baechle** and **W. P. Thomson** have been appointed group leaders at the laboratory.

#### OBITUARIES

**William R. Lawrence**, sales engineer with Oliver United Filters Inc., died September 11 at his home in Riverdale, N. Y. Mr. Lawrence specialized in the pulp and paper manufacturing field.

**Jesse B. Turner**, plant superintendent of Atlas Powder Co.'s Giant (Calif.) plant until his retirement in 1949, died October 12 at the age of 70.

**Swain J. Swainson**, for many years director of American Cyanamid Co.'s mineral dressing laboratories at Stamford, Conn., died October 22 at Southold, L. I., after a prolonged illness.

**Paul E. Hurley**, 53, manager of Shell Oil Co.'s Houston, Tex. refinery, died of a heart attack on October 26 in New Orleans, La.

**Dan McAfee**, executive vice president of the Provident Loan Society of N. Y., died suddenly on October 28. Before joining Provident Loan in 1943, Mr. McAfee had been with the Dorr Co. for 27 years.

**Logan H. Leggett**, engineer for Humble Oil and Refining Co. in Houston, Tex., died of an accidental shotgun wound on November 3. Mr. Leggett was 39 years old.

**Edgar S. Browning**, 63, founder and president of E. S. Browning Co., San Francisco, chemical distributors, died November 10 at his Piedmont home.



## Direct Fired Air Heaters

COMPACT...ECONOMICAL...HIGHLY EFFICIENT

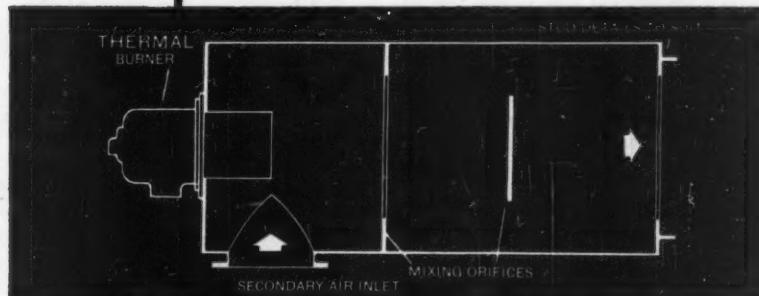
#### EASILY INSTALLED...EASILY ADAPTED

Readily fitted to ovens, kilns, spray dryers, etc., the THERMAL Type CA Air Heater is an ideal source of heat where products of combustion may be mixed with the air. Units for operation against high pressure are available in the same simple design as those for atmospheric pressure levels.

#### NO REFRactory REQUIRED...

The THERMAL High Velocity Burner built into the Type CA Air Heater provides for combustion to be substantially completed within the burner itself. Thus the heater is basically a mixing chamber wherein the products of combustion are mixed with the air being heated. Refractory is not normally used in the heater.

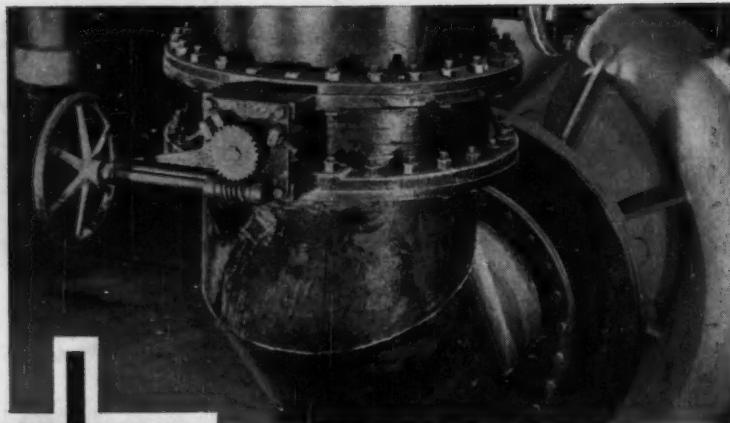
FOR DETAILED INFORMATION WRITE FOR BULLETIN 104



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R-S  
BUTTERFLY VALVES

This 30" R-S Butterfly Valve is in check service on a cold air line. Note the unusual compactness and simplicity of design.



Three 20" R-S Butterfly Valves are used in hot-gas lines handling highly corrosive gas year 'round.

## SAME R-S VALVES MEET EXTREMES OF SERVICE

R-S Butterfly Valves were chosen to meet the varied demands of a sulfuric acid plant producing 600 tons per day on a year-round schedule. On the hot side of the process, 20" R-S Butterfly Valves are used for fast, dependable volume and temperature control. They are on the hot-gas lines at the heat exchangers where temperatures are a constant 1150 F.

On the cold side, 30" R-S Butterfly Valves meter cold air at 30,000 cfm to the sulfur gas furnaces. Two 20" valves are used in by-pass airlines, safeguarding the proper air-sulfur mixture. They were chosen for their ability to move fast — fast enough to ensure close control of an unstable compound which becomes useless if too much hydrogen or oxygen is added.

Regardless of the unusual or critical factors in your process, SMS offers the valve line which will more than adequately answer your needs. For information on the R-S Butterfly and SMS Ball and Rotovalves, contact your local representative or write the S. Morgan Smith Company, York, Pa.

Hydraulic Turbines  
Pumps

Gates & Hoists  
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### HYDRODYNAMICS

Rotovalves  
Ball Valves  
Butterfly Valves

Free-Discharge Valves  
Controllable-Pitch Ship Propellers

**S. MORGAN SMITH CO.**

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

### THIS MONTH'S

## Letters:

### Inventory Issue: Mostly Pro

Sir:

I have just received and studied the First Annual Inventory issue of Chemical Engineering. This will be of great value to the chemical industry, and I am delighted to see McGraw-Hill make such a publication.

EDWIN COX

Vice President  
Virginia-Carolina Chemical Co.  
Richmond, Va.

► CE's 1st Annual Inventory Issue, published in mid-October, has been received with a great deal of interest and comment. The above letter, and the three that follow, are typical of the reactions to this publishing innovation. — Ed.

Sir:

Your Inventory Issue is a fine service to your readers . . . in both contents and format. As an engineer who deals constantly with equipment, I was particularly grateful for the section that summarizes equipment developments. I expect to use it often, and for many years. . . .

W.M. B. FRANKLIN

Shell Oil Co.  
Houston, Texas

► This 69-page section on equipment and accessories digests some 570 major developments of interest to chemical engineers that were announced during the period July 1953-June 1954. — Ed.

Sir:

Congratulations on the thoroughness of your Inventory Issue, which I have carefully studied. It is a useful job . . . and my only criticism in this respect is that it could have been made even more useful if you had given literature references in the section covering New Processes and Technology.

HOWARD WELLS

Chemical Engineer  
E. I. du Pont de Nemours &  
Co., Inc.  
Wilmington, Del.

► We considered literature references for this section, decided against them

## Pro & Con

when we realized that most of the references (close to 70%) would be to brief news announcements only. In other words, most of the developments are so recent that technical details have not yet been published. — ED.

Sir:

I'm delighted to see CE's Inventory Issue and the comprehensive, yet useable, way it has digested important developments in the various fields. Only a person who has tried to do such a job (as I have, to a small extent) can appreciate the time and effort it involves. . . . I hope you will make your Inventory an annual event?

J. A. CARPENTER, JR.  
Standard Oil Development Co.  
Elizabeth, N. J.

► Yes, our Inventory Issue will be on an annual basis. We've already started work on the 1955 issue. — ED.

### Not a Matter of Morals

Sir:

Are we engineers different from common people or are we more moral?

Any non-technical magazine advertises with the help of pretty girls and Bikini micro-bathing suits. Why shouldn't you advertise in the same way?

Of course there are a few exceptions, like every month's Gelb girl and few others . . . with too much clothing!

THOMAS GARCIA B.

Chief Chemist  
Lab. TUGN  
Petroleos Mexicanos  
Poza Rica, Ver. Mexico

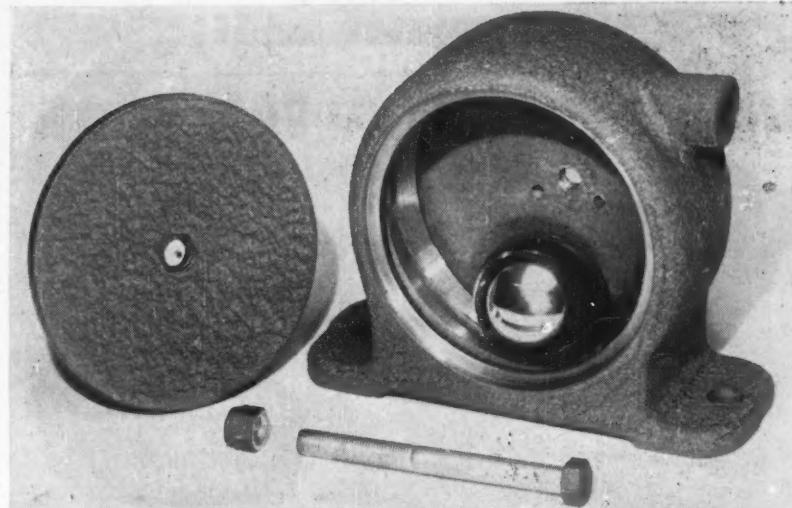
► We're not different, nor more moral—only shy about such things—ED.

### Solid-to-Solid Heat Exchange

Sir:

In the October issue of Chemical Engineering I read with much interest the article entitled "Capturing Rotary Kiln Heat."

A well-known Swedish engineering firm, Aspegren & Co. of Stock-



## **new airoviber moves bulk materials, quickly, quietly, and effectively...**

**AiroViber simple design provides dependable, trouble-free vibration**

This new method of external vibration can be used to good advantage in loading, unloading, moving, packaging, processing, grading or separating bulk materials.

The AiroViber is able to deliver effective and dependable vibration with only one moving part, a heavy steel ball running on a circular track. The pounding usually associated with the ordinary types of vibration has been eliminated with the special noise lessening design, exclusive with AiroViber.

**Simplified Design:** AiroViber's one moving part is a steel ball. An air jet blows it at high speed around a ground and hardened steel track in the housing. The weight of the ball develops a strong centrifugal force, which the vibrator transmits through its mounting into the object to be vibrated. It will start and operate under any condition and performs at high or low temperatures. AiroViber is not affected by humidity.

**Trouble-Free Operation:** The AiroViber is almost fool proof in operation. Because it has no close fitting parts to lubricate or adjust, it will start every time you open the air valve. You can install it in hard to get at locations with full confidence

that it will operate without lubrication or maintenance for a long time.

**No Installation Problems:** AiroViber is easy to install. It does not need any special line oilers or air filters. Merely hook up an air hose large enough to deliver the air specified for the unit you select.



AiroViber rotary vibration breaks up arching and jamming in bins, hoppers, chutes, feeders, and other places where bulk materials hang up. It is also recommended for vibrating tables or platforms, sorting and many other applications.

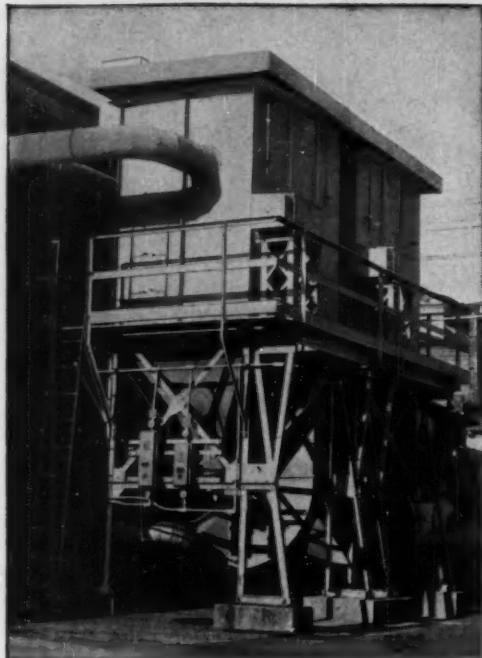
AiroViber is a product of the Viber Company, leader in the field of vibration. For further information, write: Viber Company, 726 South Flower St., Burbank, Calif. CE72



CONCRETE VIBRATORS SINCE 1931

# SLY

PIONEERS and LEADERS  
in INDUSTRIAL DUST CONTROL



Sly Dust Filter at the plant of Merck & Co., Inc., Rahway, New Jersey.



Packaging Unit showing exhaust duct connected to Sly Dust Filter.



THE W.W.

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Cincinnati • St. Louis • Minneapolis • Birmingham • Los Angeles • Toronto

## PRO & CON . . .

holm has developed a new idea in connection with rotary kilns which is explained in the enclosed copies of the two issued U. S. Patents. We have the exclusive rights to the use of these patents for this country.

There are many applications for this method of solid-to-solid heat exchange, one of them being in the field of retorting oil shale, another one in the field of roasting low-grade iron ores in the presence of hydrogen, and another one in connection with the disposal of saw-mill waste.

It can also, of course, be applied for the cooling of hot solids. It is extremely efficient because of the counterflow of the steel balls. Balls of other material can also be used; in connection with oil shale we anticipate using balls made of the spent shale.

H. E. LINDEN

President  
Linden & Co.  
Beverly Hills, Calif.

► We appreciate this additional and valuable information on the Aspegren developments. The two patents referred to are U. S. 2,592,783 (O. E. A. Aspegren, Rotary Heat Exchanger, April 15, 1952) and U. S. 2,420,376 (E. A. Johansson, Destructive Distillation Process Embodying Counterflow of Solid Heating Medium, May 13, 1947). —Ed.

## More on Corrosion Resistance

Sir:

I enjoyed your 16th Biennial Materials of Construction Report that appeared in the November issue. A very neat and concise job!

However, I was disturbed by statements made in the discussions of stainless steels and lead. In both cases it was stated that proper treatment of the metal surface would result in improved corrosion resistance.

The protective film that exists on the surface of stainless steel and other chromium-containing alloys is very delicate. In fact, it is believed that this film is a dynamic phenomenon-destruction followed by repair. This is supported by the observation that even passive stainless corrodes at a slow but measurable rate.

Therefore, the important point to consider is the passivating capacity of the medium. If the passivating capacity of the corrosive is insufficient to repair holes resulting from chemical or mechanical damage, look out! "Passivating" treatments will not improve the resistance of stainless steels because sooner or later, damage to the protective film will permit attack.

This same argument applies to the formation of sulfate films on lead. The initial state of the metal, coated or uncoated, is not important.

N. D. GREENE JR.  
Research Fellow  
Corrosion Research Laboratory  
Engineering Experiment Station  
Ohio State University  
Columbus, Ohio

► Corrosion engineers will appreciate this additional information on the surface treatment of stainless steels and lead. — Ed.

#### Bag Packer vs. Bag Loader

Sir:

There appears to be some confusion among users as to the difference between a bag loader and a bag packer.

One of the earliest and most successful bag packers consists of an auger inside a tube, the bag being pushed up over the tube until the bottom of the bag is against the end of the tube where it is held by a movable platform. When the auger is started, the material is pushed into the bag and the platform is pushed downward. The pressure on the packed material is regulated by the resistance of the platform and the resistance is controlled by a friction brake. With this system there is no fluffing of the material in the bag and no air entrainment as the bag is filled.

A bag filler drops the loose material into the expanded open bag so it fluffs and entrains a maximum amount of air. Some of these devices shake the bag while others vibrate it, but this does not eliminate air entrainment and only partially controls the density of packing.

## Helicoid Chemical Gage



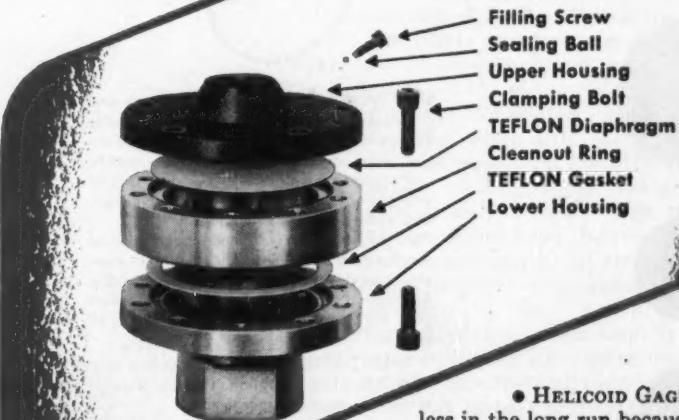
### Gages for corrosive chemicals and liquids up to 5000 p.s.i.

• Here's an accurate pressure gage for chemicals and other viscous liquids which might corrode or clog the Bourdon Tube. It registers working pressures from 30" vacuum to 5000 p.s.i. and temperatures to 400°F.

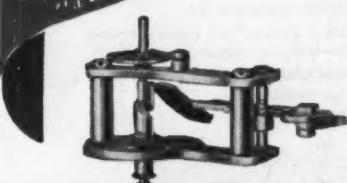
Guaranteed accuracy plus or minus 1%.

A single diaphragm seals off objectionable substances from the indicating gage. This gage is filled completely with specific inert liquids and pressure is transmitted directly to the indicating gage through deflection of the sealing diaphragm.

#### FEATURES



• HELICOID GAGES cost less in the long run because they give long, trouble-free service with a minimum of maintenance. The movement is a simple cam and roller design that does not have any gear teeth to wear out. It has been tested and proved in years of hard service.



Only Helicoid Pressure Gages  
Have the Helicoid Movement

Write for Catalog Today

**ACCO**



**Helicoid Gage Division**

**AMERICAN CHAIN & CABLE**

927 Connecticut Avenue • Bridgeport 2, Connecticut



Know  
the advantages  
**PARTLOW**  
**INDICATING**  
**CONTROLS**  
offer you

SEND  
FOR  
NEW  
CATALOG

COVERS  
ALL  
APPLICATIONS

SEND NOW for your copy of Partlow's new Condensed Catalog CC. See how the many Partlow Mercury Actuated Indicating Controls have been engineered with specific advantages for maximum efficiency in specific applications within -30°F to 1200°F range. One example is the versatile Model LSS — it does the job of two independent controls and may be used for four specific heating or cooling control systems. In addition to special application features like this, Partlow offers you all these quality advantages on all controls:

1. DIRECT-ACTING hermetically sealed Mercury Bulb instrumentation. Positive, precise, sensitive — never temperamental.
2. INTERCHANGEABLE ELEMENTS — for quick, easy field replacement, without returning control to factory.
3. ACCURATE CALIBRATION — conservatively, within 1% of scale range.
4. LONG LIFE — thick-walled capillaries and seamless tubing assure almost indefinite life.
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the pioneer in mercury thermal controls

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## PRO & CON . . .

A thorough appreciation of these fundamental differences in action can save much money for users in inept experimentation on non-free flowing materials. The big trick in setting up a packer installation is to get the material into the auger.

The old flour mill auger-type packer was provided with a clutch and required considerable manual effort on the part of the operator. However, these machines may easily be made semi-automatic and quite rapid when desired.

IRVING A. BUTCHER  
Consulting Engineer  
Cincinnati Time Recorder Co.  
Cincinnati, Ohio

### Rebuttal to Wells

Sir:

Please don't let reader Kenneth S. Wells (CE, Oct. '54, pp. 359-60) talk you out of "You and Your Job." That's one of the main columns that got me to subscribe to your magazine.

Another thing — that piece "Breakdown vs. Preventive Maintenance" may not have said much of anything to him, but it was a darn good general article for a young non-manufacturing man like me.

And still another—his implicit notion that theory cannot be practical is arrant nonsense and suggests that he is one who needs it most.

Finally—his tagging you "fair to mediocre" is quite undeserved. You put out a good to excellent magazine with nicely balanced content.

You are especially to be complimented on your new format and even more so for the type of thinking that prompted it.

P. D. GEORGE  
Schenectady, N. Y.

► There's a pro-and-con to everything we do. For another rebuttal to Reader Wells' cons, see the letter that follows.—ED.

Sir:

In reading the October 1954 issue, I was prompted to write to you in connection with a letter published from Mr. K. S. Wells.

He seems to dislike articles tend-

ing to delve into theory. I am surprised at Mr. Wells; does he think that theory is something to be left in the classrooms of the Universities?

It is my belief that theory (dull as it may be to read at times) goes hand in hand with many engineering assumptions; therefore engineers should be exposed to it when the occasion warrants. The CE Refresher course is a practical publication of theory, but none the less it is theory. May I take this opportunity to congratulate the CE staff; the Refresher series is excellent. I hope to see it continued with other topics.

The "Technical Bookshelf" and "You and Your Job" are checked as useless by Mr. Wells. I think he has overlooked individual tastes. To me those are both interesting sections of CE that I never miss reading.

Your "Reader Service" department is in my estimation near perfection for clarity, speed, and ease in its use. The layout of ads and technical literature is superior to any other journal I have ever subscribed to or read.

My heartiest approval of CE goes to the entire staff.

R. M. CLARKE

Chemical Engineer  
Yale University  
New Haven, Conn.

### Dehydrohalogenation?

Sir:

A recent letter in *Chemical Engineering* concerning a "new unit operation" prompts me to write concerning the neglected field of dehydrohalogenation.

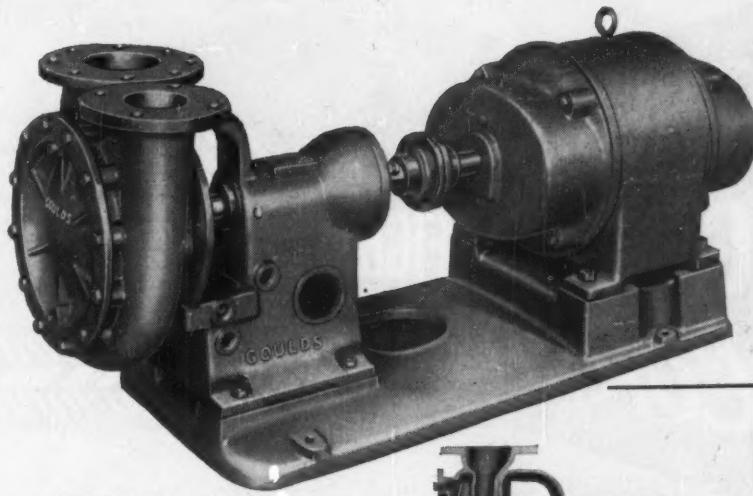
Whole chapters are written upon "the addition of halogen acid." Yet a recent text has only two pages upon "subtraction." A friend advises that "there is no theory" for this operation.

For what good reason has research so carefully avoided this field? Must it be a sacred cow?

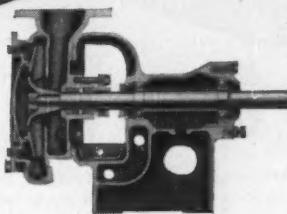
R. E. BOWMAN

Blacksburg, Va.

Does anyone wish to come forth with a defense of the "sacred cow" of dehydrohalogenation? — Ed.



The entire fluid end of this chemical pump is available in any of the following metals: 316, Gould-A-Loy 20, 304, all iron, all bronze or bronze fitted, all iron with stainless trim. Nine sizes ranging from  $\frac{3}{4}$ " to 3"; capacities up to 720 GPM; heads to 200 ft.



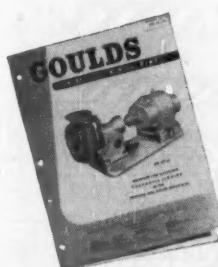
## You get a lot for your money in this new chemical pump

New design features of the Goulds Fig. 3715 centrifugal pump offer you special operating and maintenance advantages in handling acids, alkaline liquors, and slurries.

The liquid end of the Fig. 3715 is the same as in its immediate ancestor, the Fig. 3705. Thousands of severe-service applications have shown us no way to improve it. But the support head is completely new. It's a sturdy, box-type design with water cooling which raises the maximum liquid temperature limitation to  $350^{\circ}$  F. It has grease-lubricated standard bearings with grease relief that helps prevent over-lubrication . . . and a simple, positive external arrangement for adjusting impeller clearance without any dismantling.

With the stuffing box under suction pressure only, you will have infrequent need for re-packing and a new freedom from excessive leakage. You can inspect and clean the interior, and you can remove or replace the impeller, without disturbing suction and discharge connections.

Bulletin 725.4 describes all the operating and maintenance advantages of the Goulds Fig. 3715 chemical pump. It defines the extensive standardization this design accomplishes for simplifying your parts inventory. It gives you detailed performance curves. We will be glad to send you a copy. Just write for Bulletin 725.4.



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*Seneca Falls  
New York*

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are far superior to ordinary gaskets for use under severe corrosive conditions. They last many times longer—even when handling stronger acids, halogens, organic solvents and other corrosives at very low, normal and even very high temperatures. They are now used for heat exchangers and columns, condensers, reactors and kettles. Where the application requires thick gaskets, Chempro Teflon Gaskets are less expensive and have better mechanical properties than solid teflon. Chempro Teflon Gaskets are made with an outer jacket of corrosive resistant Teflon and with a resilient and flexible core of compressed asbestos and laminated woven asbestos sheets. Other special core materials can be used depending upon your specific needs.

Chempro designs and manufactures a complete line of packings and gaskets in Teflon and other plastic materials. Look over the series shown below. There's a type to fit your special needs.

**Style 10-1—Teflon\*** Jacket. Center core of compressed asbestos between woven asbestos cloth.

**Style 10-2—**Same as above but with corrugated Stainless Steel core. For higher operating pressures.

**Style 10-3—Teflon Jacket.** Compressed asbestos core 1/16" or 1/8" thick for applications where less deformability is needed or desirable.

**Style 10-4—Teflon Jacket.** Corrugated Stainless Steel insert. For high temperatures and pressures and low bolt loads.

**Style 10-5—Teflon Jacket.** Neoprene core 1/16" or 1/8" thick. For applications requiring greater deformability.

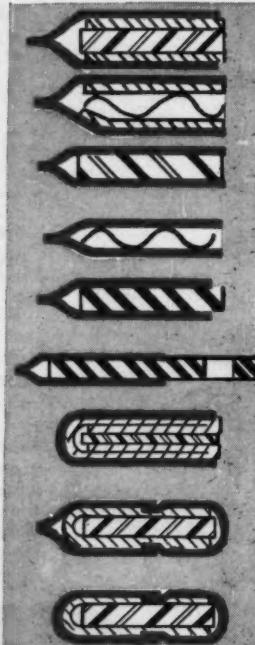
**Style 10-6—Teflon Jacketed Full Face Neoprene Gasket with Bolt Holes.** Core may be of any construction or variety of specified material.

**Style 20-1—Method of Teflon Jacketing** special sizes, irregular shapes and diameters of 12" and over.

**Style 220-1—Double Teflon Jacket** using Envelope on I. D. and Molded Shield on O. D. for protection from extreme corrosion. Compressed asbestos center core between Woven Asbestos Cloth.

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\*du Pont Trademark

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THIS MONTH'S

## Technical

### For First Introduction

ELEMENTARY CHEMICAL ENGINEERING. By M. S. Peters. McGraw-Hill Book Co., N. Y., 322 pages. \$6.

What does a chemical engineer do, anyway? Max Peters answers this question—both for students who are nonmajors and for chemical engineering beginners—in this latest edition to the McGraw-Hill Series in Chemical Engineering.

Essential purpose of this text is to give a unified picture of chemical engineering as a profession by emphasizing development, applications and the interrelationships of its fundamentals. Basic information on stoichiometry, equipment, unit operations, chemical economics and plant design is included.

Though primarily intended for use with a full-year fundamental course (or as a one-semester survey for nonmajors), Professor Peters puts unusual emphasis on practical applications. This should make the book useful to industrial chemists, supervisors, executives, salesmen and the chemical engineer who needs some brush-up on fundamentals.

Where the mathematics involved would be above the level of many readers, simplified derivations are given. More extensive derivations are in the appendix. Also by consulting the answers in the appendix, students can find out immediately if they have correctly solved the problems that follow most chapters. Many completely worked out examples are scattered throughout the text.—RFF

### Unit Techniques

THE TECHNICAL REPORT. Edited by B. H. Weil. Reinhold Publishing Corp., New York. 485 pages. \$12.

With commendable acumen the publishers aver that here we have "the only book to cover all the following important phases: writing,

## Bookshelf

L. B. Pope

illustrating, editing, duplicating, binding, distributing, security, filing." This is true, but it would be easy to question just how well these important phases were "covered."

With greater grace the editor regards it as a handbook of unit techniques. And considering its origin, the book does approach this ideal rather well.

About 75 percent of "The Technical Report" is based on society papers. They have been reworked but they still preserve some of the flavor of their origin.

More than half of the book is concerned with the details of distributing, filing and using reports. In this area, the various authors expound in considerable detail on their specialties. Chemical engineers with production problems will relegate these subjects to their librarians.

In any mass-authored jobs, it is difficult to get an over-all integration of the book's content. Weil has done a sturdy job and his book will serve as a guide to many prospective authors and speakers.

When you are faced with the necessity for writing or making a report, Weil's handbook should be consulted. A helpful idea is sure to emerge.

### 22<sup>o</sup>. Tabular

IMIDAZOLE AND ITS DERIVATIVES. Part I. By Klaus Hofmann. Interscience Publishers, New York. 465 pages. \$13.50.

Reviewed by A. H. Blatt

This monograph reviews the material published on the chemistry of imidazoles and benzimidazoles during the years 1919-1950. The material is divided into about 320 pages of text and about 90 pages of tables. The eight chapters of text deal with (1) general properties and structure of imidazoles, (2) alkyl and aryl derivatives, (3) oxo and oxy derivatives and their sulfur analogs, (4) halogen derivatives,



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99.5% Chemically Pure Cellulose

SOLKA-FLOC is now being used as a filter-aid for a rapidly growing number of food products—proof that SOLKA-FLOC gives the clearest, purest filtrate at high flow rates.

The finely-divided cellulose particles of SOLKA-FLOC form the perfect filter barrier—trapping even the tiniest of suspended solids. SOLKA-FLOC can be handled readily with a knife, will not gouge...gives a more stable cake, will not bleed...gives longer life to the precoat...is chemically inert...easily washable...can be burned to recover any valuable solids remaining.

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& Wettre, Ltd.  
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## **Oil company reports**

**LATTICE BRAID<sup>\*</sup> Teflon<sup>†</sup> PACKING**  
**Gives 10 months service where ordinary pump packings needed replacement twice a week!**



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Garlock makes LATTICE BRAID  
rod and shaft packings.

The centrifugal pumps at Bray Oil Company of Los Angeles handle at different times alcohol, caustic, lime solution, acid sludge and dry solvent. The pumps are steam cleaned between usages of these different commodities. Under these tough service conditions ordinary pump packings last only 2 to 3 days; either the shaft or sleeve had to be replaced every 6 months. Ed Jones, maintenance superintendent at Bray, reports that currently LATTICE BRAID Teflon packing has given over 10 months service, and no shaft or sleeve replacement has been necessary in that time!

Put Garlock LATTICE BRAID Packing to work for your company. All the braided strands of this unique packing are lattice linked together into one structural unit. The strands hold together even when the packing is worn far beyond the limits of wear of ordinary braided packings.

LATTICE BRAID is made from flax, cotton, asbestos, wire-inserted asbestos, Teflon, and asbestos with Teflon impregnation—for various types of services.

*Get all the facts about LATTICE BRAID Packings. Contact your Garlock representative or write for new folder AD-131.*

### **THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK**

*Sales Offices and Warehouses:* Baltimore • Birmingham • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Denver • Detroit • Houston • Los Angeles • New Orleans • New York City • Palmyra (N.Y.) • Philadelphia • Pittsburgh • Portland (Oregon) • Salt Lake City • San Francisco • St. Louis • Seattle • Spokane • Tulsa.

*In Canada:* The Garlock Packing Company of Canada Ltd., Toronto, Ont.

<sup>†</sup> The Du Pont Company's Trademark

**GARLOCK**      **LATTICE BRAID**  
**PACKING**



### **BOOKSHELF . . .**

(5) nitro, arylazo, and amino derivatives, (6) carboxylic and sulfonic acids, (7) di- and tetra-hydro derivatives, and (8) benzimidazoles. The tables list the individual compounds that have been reported, give for each compound the melting point or the melting point of a suitable derivative (e.g. picrate, hydrochloride), and give a literature reference.

For any one wishing to locate a particular imidazole or to acquire general familiarity with the chemistry of imidazoles, this monograph is essential. In addition, it should stimulate further work on imidazoles, for there are many areas in the chemistry of this heterocyclic system that require additional experimental work or critical analysis or both.

### **Neither nor**

**INDUCTION AND DIELECTRIC HEATING.** By J. Wesley Cable. Reinhold Publishing Corp., New York. 565 pages. \$12.50.

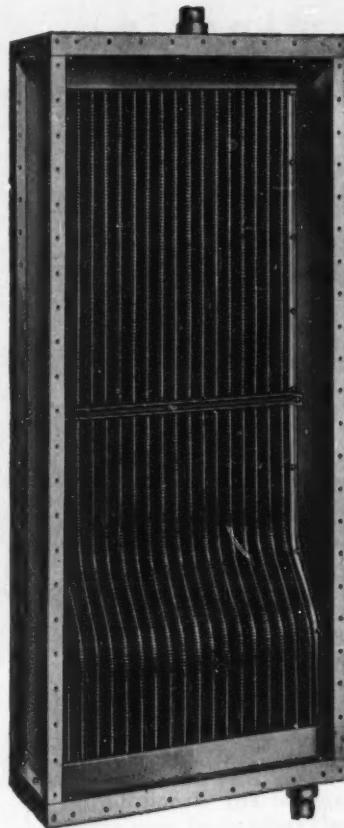
Reviewed by Max Wulfinghoff

Here are almost 600 pages of text on two specialized heating methods, forming a volume that is neither treatise nor handbook nor encyclopedia.

While going to great lengths on the subject of applications, the work is curiously lacking in coordination and in depth. It sidesteps a discussion of basic concepts (except some elementary ones), gives little on numerical relations or characteristic ratios, few reference dimensions, hardly any selection or calculation data, no complete numerical examples, and little help in either detail design or equipment layout. Neither is there any systematic analysis of plant economics, efficiencies or performances. It does not give a well-rounded picture of the state of the art; while it reports on some highlights of American practice, developments abroad are ignored.

A patent summary, author index, and bibliography are all lacking.

# EFFICIENT Extended-Surface HEAT EXCHANGERS

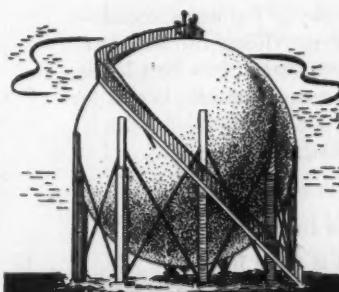


for  
**HEATING  
COOLING  
PROCESS  
AIR  
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## ASK THE AEROFIN MAN

Your Aerofin man's recommendation means high efficiency, long service life, low maintenance costs.

Aerofin's unequalled laboratory and manufacturing facilities — unequalled knowledge of heat-exchange practice — are devoted exclusively to the design and manufacture of highest quality extended heat surface.



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**Aerofin units do the job  
Better, Faster, Cheaper**

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*Aerofin is sold only by manufacturers of  
fan-system apparatus. List on request.*

Some spelling errors are irritating, as nickle for nickel, Seimens for Siemens. What holds for the text goes also for the illustrations which are largely somewhat uninformative, and mostly taken from trade catalogs; some of them could have been left out without detriment to the whole.

However, the text will give to readers unfamiliar with the heating methods under consideration a bird's-eye view of their applicability in a number of commercial fields.

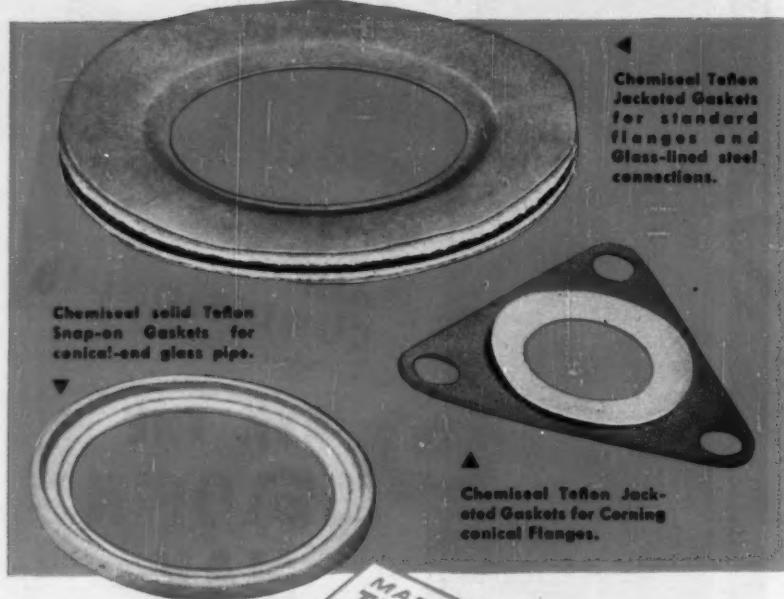
### Recent Books Received

- Cellulose and Cellulose Derivatives.* 2nd ed., Part II. Ed. by E. Ott, H. M. Spurlin & M. W. Grafflin. Interscience. \$12.
- Coal.* By W. Francis. St. Martin's Press. \$17.50.
- Colorimetric Methods of Analysis.* By F. D. Snell & C. T. Snell. Van Nostrand. \$12.50.
- Conveyors and Related Equipment.* 3rd ed. By W. G. Hudson. Wiley. \$9.
- Deterioration of Materials.* By G. A. Greathouse & C. J. Wessel. Reinhold. \$12.
- Electrometric pH Determinations.* By R. G. Bates. Wiley. \$7.50.
- Hugh Roy Cullen.* By E. Kilman & T. Wright. Prentice-Hall. \$4.
- Manual on Industrial Water.* American Society for Testing Materials. \$5.
- Manufacture and Application of Lubricating Greases.* By C. J. Boner. Reinhold. \$18.50.
- Monomeric Acrylic Esters.* By E. H. Riddle. Reinhold. \$5.
- Nuclear Species.* By H. E. Huntley. St. Martin's Press. \$4.50.
- Organic Analysis.* Vol. 2. By J. Mitchell, Jr., I. M. Kolthoff, E. O. Proskauer & A. Weissberger. Interscience. \$8.50.
- Packaging Engineering.* By L. C. Barail. Reinhold. \$9.50.
- Physical Measurements in Gas Dynamics and Combustion.* By R. W. Ladenburg, B. Lewis, R. N. Pease & H. S. Taylor. Princeton. \$12.50.
- Physical Methods and Organic Chemistry.* 2nd ed. Part III. By A. Weissberger. Interscience. \$8.50.
- Soil.* By G. V. Jacks. Philosophical. \$5.
- Solvents and Allied Substances Manual.* By C. Marsden. Elsevier.
- Tales of a Sugar Tramp.* By E. C. Freeland. Pelican. \$5.
- Treatise on Applied Hydraulics.* 4th ed. By H. Addison. Wiley. \$9.50.
- Water Conditioning for Industry.* By S. T. Powell. McGraw-Hill. \$9.

**Impervious to**

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## Chemiseal Gaskets

Here are Gaskets that will seal against any chemical your process equipment and piping can handle—and then some. With proper installation, they will last as long as the equipment, corrosion-wise.

And they are made specifically to suit every connection problem—every pipe and nozzle material requirement, whether glass, ceramics, stainless, Karbate, Haveg, glass-lined steel, etc.

They are designed to protect these costly piping materials—usually low in impact strength—by providing the necessary cushioning effect to permit a positive seal at low bolt loads. Solve your gasketing problems once and for all. Write for Catalog No. TG-953.



THIS MONTH'S

## Recent Books

### Operations Research

Management's newest enthusiasm—operations research—promises much. It can be applied to marketing, inventory control, programming, costs and even to office routines. 185 pages.

"Proceedings of the Symposium on Operations Research in Business and Industry." Midwest Research Institute, Kansas City, Mo. \$5.

### Refractometry

How to determine indexes of refraction of solids by microscopical methods. Primarily for mineralogists but useful to almost any user of the microscope. 60 pages.

"Practical Refractometry by Means of the Microscope." By R. M. Allen. R. P. Cargille Labs., 117 Liberty St., New York 6, N. Y. \$1.

### Grays Harbor

Features of this Washington area of interest to industry: water supply, transportation, population, industries, raw materials and other industrial location facts.

"The Grays Harbor Area." Ivan Bloch and Associates, 611 Park Bldg., Portland 5, Ore.

### Fertilizers

Although this manual was originally prepared for instructing supervisory personnel, a new edition now will serve well as a handbook of fertilizer manufacture. 179 pages.

"Manual on Fertilizer Manufacture." By Vincent Sauchelli. Davison Chemical Co., Baltimore, Md. \$4.50.

### Purging

Describes methods of procedure for safely removing and adding equipment to a gas system. This manual is not an operating code. Includes supervision, personnel and

## & Pamphlets

planning as well as methods and equipment. 225 pages.

"Purging Principles and Practice." American Gas Association, 420 Lexington Ave., New York 17, N. Y. \$6.

### Corrosion

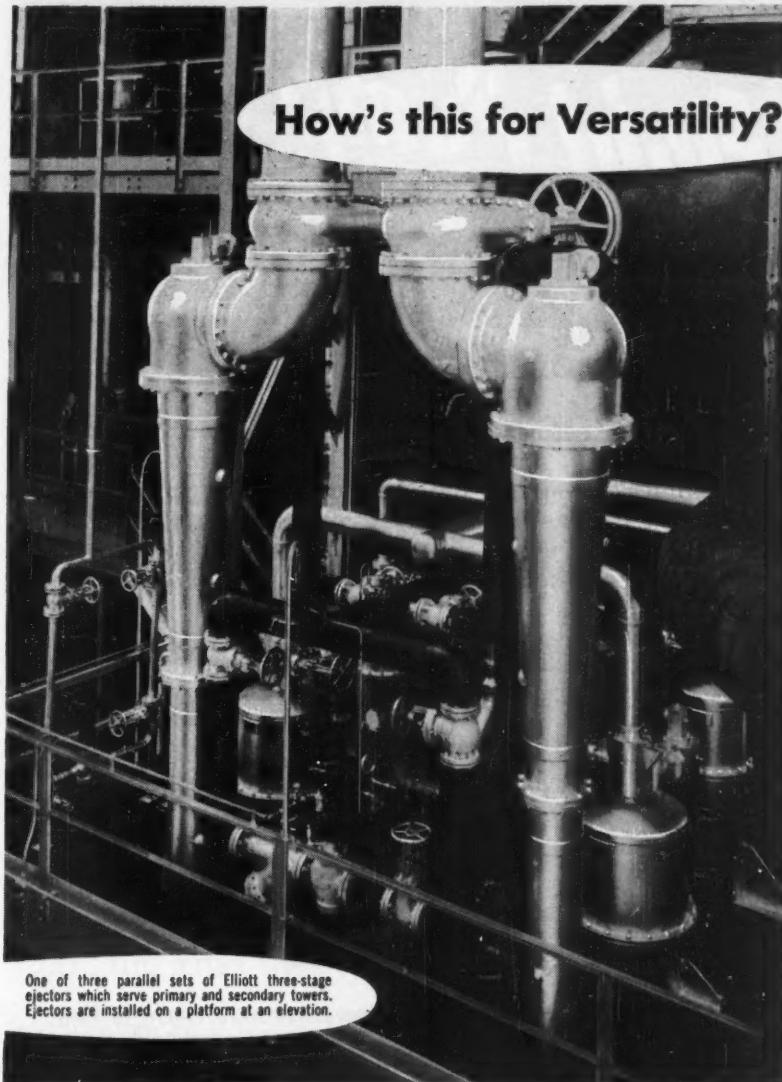
27 investigators from 10 different countries spent 6 weeks visiting 41 different American companies and institutions. They studied problems of maintenance, with special reference to corrosion. This is their report. It is a valuable summary of American practice covering, in 11 chapters, theory, protective techniques, anti-corrosive and heat-resisting materials. 129 pages.

"Corrosion Problems and Prevention in the Chemical and Petro-Chemical Industries in the U. S. A." Organization for European Economic Co-operation, Publications Office, 2002 P St. N.W., Washington 6, D. C. \$1.50.

### Products & Processes

Containing 1,350 abstracts or brief descriptions of government-owned inventions in the chemical field, this volume is one of seven prepared by the Government Patent Board. Each listing includes title and number of the patent, name of the inventor, name of the government agency administering the patent. Abstracts are grouped under 19 classifications as to industrial use. None of our industry groups can afford to ignore the availability of these patents, to themselves and to their competitors. Other books in the currently available series cover instrumentation; food products and processes; metal processes; electric and electronic apparatus; ordnance; and ceramic, paper, rubber, and other processes.

"Chemical Products and Processes." PB111465. Office of Technical Services, Washington 25, D. C., 101 pages. \$3.



One of three parallel sets of Elliott three-stage ejectors which serve primary and secondary towers. Ejectors are installed on a platform at an elevation.

## ELLIOTT Steam Jet EJECTORS

This installation in a large oil refinery called for three parallel sets of Elliott three-stage steam jet ejectors. Parallel ejectors permit one set to be shut down during reduced rates, making for greater economy in steam consumption. They operate on 100 psig steam, maintaining vacuum on both the main unit and the secondary tower. Tower pressure is controlled by recycling gases from the third-stage ejector discharge back ahead of the first stage ejector.

Whenever vacuum is required, it pays to utilize the know-how of Elliott ejector specialists. Contact your Elliott representative or write Elliott Company, Jeannette, Pa. for descriptive bulletins.

**ELLIOTT Company**

G5-1

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

# Fight Pump Wear with Colmonoy SPRAYWELDING

COLMONOY hard-facing protects against corrosion and abrasion . . . makes pump plungers, pistons, rings, bushings, any pump part last longer. The Sprayweld Process eliminates time consuming hand application and warpage, and it allows complete control over the smooth application of the alloy in powder form.



Spray it . . . Fuse it

The COLMONOY Spraywelder applies COLMONOY alloys to the wear areas of any metal part. The sprayed overlay is then welded to the base metal by fusing it with an oxy-acetylene torch. The even application makes the removal of more than .010" per side in finishing very rare.

A COLMONOY Sprayweld surface is non-porous, non-sparking, and has a low coefficient of friction. It resists corrosion, abrasion, and oxidation.



This acid sludge pump plunger was being repacked every 8 hours, and replaced every 24. At half the cost of new plungers, Spraywelding with COLMONOY No. 6 stretched repacking intervals to 60 hours, and increased total life to 573 hours.

Write today for the new catalog describing the Model C Spraywelder.



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## THIS MONTH'S

### Firms in

#### New Lines

Borden Co., has entered the Mexican industrial adhesives manufacturing field upon the completion of a resin production run in Mexico City.

Vitro Corp. has entered the field of uranium mining. It has acquired 57 uranium claims from the Sateco Mining Co., Wyoming.

#### New Representatives

Warwick Wax Co. has named the Dixie Solvents & Chemical Co., Louisville, Ky., as exclusive distributor in that state.

Cochrane Corp., Philadelphia, has appointed the Turbine Equipment Co. as a representative.

Hercules Powder Co. has selected McKesson & Robbins, Inc., as a distributor for products of its Naval Stores Dept.

Brown-Allen Chemicals, Inc., Staten Island, N. Y., has appointed Grant Chemical Co., Boston, as agent for its paints and varnishes.

Ampco Metal, Inc., Milwaukee, has named the O'Neill Pump & Eng. Co. as distributor for its centrifugal pumps, in Richmond, Va.

Diamond Alkali Inter-American Corp. has appointed Fernando Castillo G-N as technical service representative for herbicides in Latin America.

Caroline Co., St. Louis, Mo., has selected Nash-Pittsburgh Co. as representative for its corrosion resistance materials.

American Water Softener Co. has named Piepenbrink Eng. Co., Chicago, as representative in the Midwest for its water conditioning equipment.

## *the News*

M. A. Gibbons

**Insul-Mastic Corp. of America,** Pittsburgh, has appointed Runnels Paint Co. as sales agent in the Pacific Northwest.

### **New Companies**

**Biotronic Laboratories**, Coventry, Conn., will manufacture fine chemicals, biochemical reagents and physical accessories.

**Fermco Chemicals, Inc.** will produce glucose oxidase-catalase and gluconic acid. Plant and offices are in Chicago.

**Controls & Instrumentation Sales Co., Inc.**, Philadelphia, will serve as sales agent for manufacturers in the Delaware Valley.

**Morse Chain of Canada, Ltd.**, is a new manufacturing subsidiary of Borg-Warner Corp., Chicago.

**Shell Chemical (Australia) Proprietary Ltd.** has been incorporated in Melbourne to control Shell interests in that country.

**Nuclear Consultants, Inc.**, has organized the NRD Instrument Co. as a corporate division—in St. Louis, Mo.

**GHK Associates**, Detroit, Mich., will offer engineering and designing services to industry.

**The Pure Fuel Oil Co.**, subsidiary of Pure Oil Co., will market fuel oil in the Chicago area.

**Talboys Instrument Corp.**, Emerson, N. J., will manufacture a complete line of variable and constant speed stirrers.

### **New Locations**

**Sharp & Dohme** biological processing operations, now being carried on in the Glenolden, Pa., laboratories will be moved to West Pt., Pa.

**Victor Chemical Works** will move from Chicago's Board of Trade

# Want Proof?



*then trust your  
own eyes!*

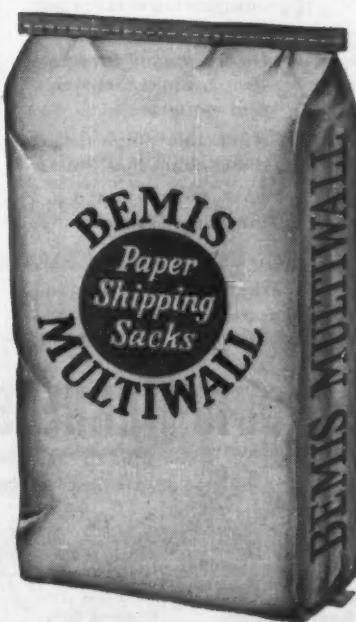
And you will know that Bemis color printing of brands on multiwall paper bags is bright, crisp, color-true . . . the kind that will boost the selling power of *your* brand.

Ask your Bemis Man to show you typical Bemis multiwall printing. Trust your own eyes.

# Bemis

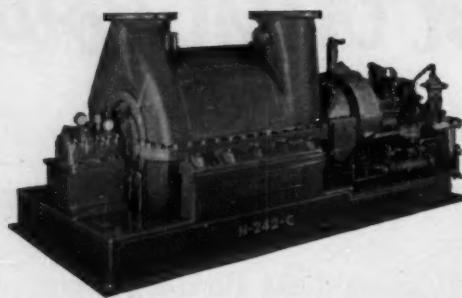


General Offices—St. Louis 2, Mo.  
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**POINTS TO  
COMPARE  
ABOUT R-C**

# Centrifugals



CHECK THE R-C  
**"BIG 4"**

1. Variable capacities, with constant pressure at high efficiency.
2. Heavy, rugged construction... minimizing noise and vibration.
3. Adaptable to high-speed, direct-connected drives.
4. Low maintenance... long-time dependability.

Check your present blowers or exhaustors—if they don't measure up, ask for suggestions from the R-C engineer.

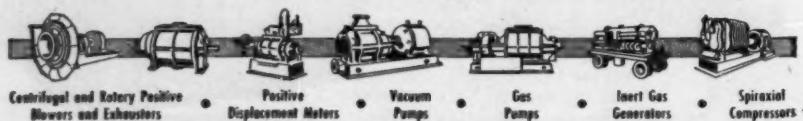
Long-time, reliable, economical operation of your Centrifugal Blowers or Exhaustors calls for this combination of "BIG 4" essentials which can be obtained only in R-C equipment.

They apply equally well to R-C Single-Stage or Multi-Stage Units, in all sizes and capacities from 2,000 cfm to 100,000 cfm. You can select an R-C Centrifugal which is closely matched to your requirements. This usually results in lower first cost and reduced operating expense.

For new installations or for replacement of unsatisfactory equipment, we suggest you call in an R-C engineer for unbiased advice.

## ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.  
155 Illinois Ave. • Connerville, Indiana



Centrifugal and Rotary Positive  
Blowers and Exhausters

Positive  
Displacement Meters

Vacuum  
Pumps

Gas  
Pumps

Inert Gas  
Generators

Spiraxial  
Compressors

## FIRMS . . .

Bldg. to 155 No. Wacker Drive,  
Chicago.

Diamond Alkali Co. has transferred its Central Engineering Dept. from Painesville, Ohio, to Cleveland.

J. F. Pritchard & Co. has removed its offices to its own new building at 4625 Roanoke Parkway, Kansas City, Mo.

Girdler Co.'s Gas Processes Div. has been moved to 301 Wright Bldg., Tulsa, Okla.

Blue M Electric Co. is moving into its new modern one story plant on Chatham St., Blue Island, Ill.

### New Names

Thurmond Industries, Inc., is the new corporate name of C. U. McClellan Laboratories Corp., Los Angeles, mfr. of insecticides.

### New Facilities

American Blower Corp., Dearborn, Mich., has opened direct factory branch offices in Portland, Ore., and Ft. Wayne, Ind.

Wyandotte Chemical Corp. has begun production at its new \$450,000 plant in Los Nietos, Calif.

Sage Equipment Co. has expanded its conveying equipment facilities in Buffalo by 30%.

Commercial Solvents Corp. has chosen Tears Engineers to design the equipment for part of its \$5 million nitroparaffin plant in La.

Dewey & Almy Chemical Co. has been merged into W. R. Grace & Co.

Ketona Chemical Corp. will construct a new plant with an annual capacity of 45,000 tons of anhydrous ammonia.

Inland Chemicals Canada Ltd. has awarded the Lummus Co. Canada Ltd. a contract to build its 100 ton/day sulfuric acid plant in Alberta.



Eimco Corp. has opened its new research and development center for liquid-solids separation through filtration.

Dow Chemical Co. has organized a research development section in its Market Research Dept.

Phillips Petroleum Co. has acquired all the capital stock of Curry Chemical Co., Inc., and 14 affiliated companies.

P. R. Mallory Plastics Co., Chicago, Indianapolis, has purchased Semrow Plastics, Inc., Chicago.

Southern Chemical Cotton Co., Chattanooga, Tenn., producer of cellulose, has constructed a new purification plant.

University of Cincinnati has completed construction of its new fluids test laboratory.

Acheson Industries, Inc., plans to construct a plant in Orange, Tex., for the production of dispersed pigments and carbon black.

Clayton Chemical & Packaging Co., Chicago, has acquired a plant at 5420 N. Damen Ave., for photographic chemicals operations.

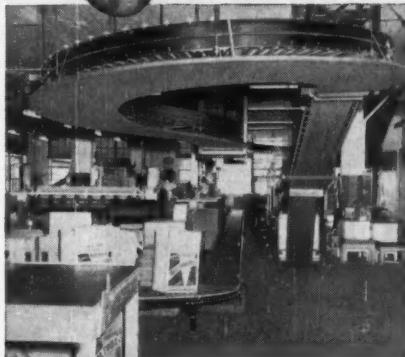
Quebec Metallurgical Industries Ltd. is negotiating for the purchase of the assets of Cobalt Chemicals Ltd., Ottawa, Ont.

Structural Clay Products Research Fdn. will construct a research center near Geneva, Ill.

Hughes-Johnson Chemical Co. has taken a lease on a tidewater property in Portland, Ore., for the



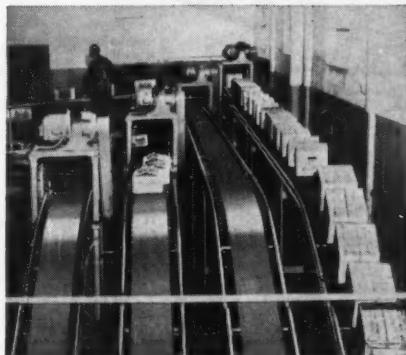
## Want to move things up →



### For lifting or lowering — floor-to-floor — the INCLINEBELT

Continuous package conveying — a complete belt conveyor system or the Inclinebelt—complete, compact easy-to-install, electric-motor powered unit. High, continuous-line load capacity for any floor elevation. Available in belt widths of 8-12-14-18-24-30 and 36 inches.

## down →

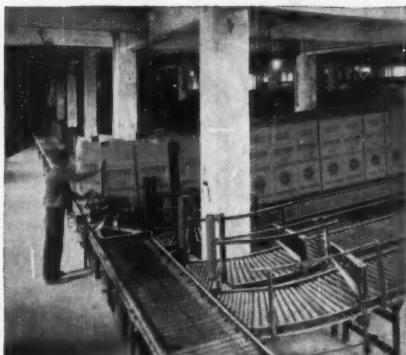


### For inclined or horizontal conveying — the UTILITY BELT-VEYOR

Conveys from floor-to-floor. Moves "packages" down, up or horizontally. Electric motor powered. Installs over existing stairways, or can be used as a portable Levelbelt conveyor. Four standard belt widths: 10-14-20 and 24 inch.

or

## horizontally?



### For straight line or inclined conveying — assemble your own system or portable conveyor using HANDI-DRIVE pre-built units

These stock, pre-built conveyor units make it easy to assemble what you want in a conveyor. Converts existing gravity conveyor to power conveyor — quickly and at low cost. Can be installed as single portable unit or complete system.

## Standard builds conveyors to speed any ONE or all THREE

Call your Standard representative listed in your classified phone book or send for illustrated Standard General Catalog describing all three units — address Dept. CE-15.

STANDARD CONVEYOR COMPANY  
General Offices: North St. Paul 9, Minnesota • Sales and Service in Principal Cities



### GRAVITY & POWER Conveyors

ROLLER • SLAT • WHEEL

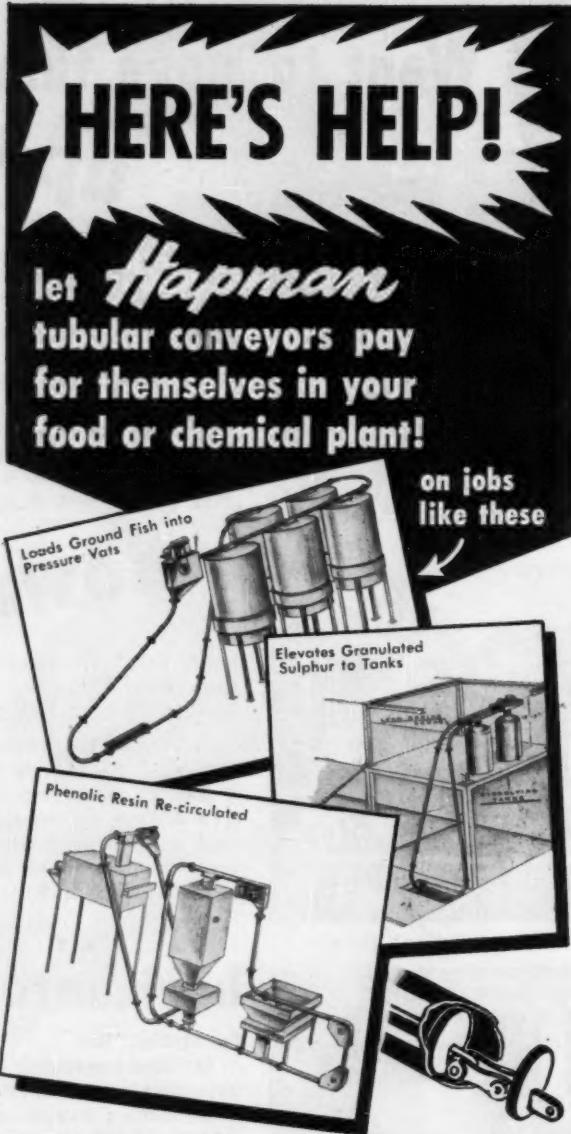
SECTIONAL • BELT • CHAIN • PUSH-BAR

PORTABLE CONVEYOR UNITS:

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HANDIPILER • LEVEL BELT • LITEWATE • HANDIDRIVE

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**CAN YOU CUT COSTS**—for a better competitive position and longer profits? Yes—through automatic bulk materials handling with Hapman Tubular Flight Conveyors! Food and chemical processors often find labor savings alone pay for this equipment in one to three years!

**ADDITIONAL BENEFITS** resulting from Hapman's unique patented design features can be equally valuable. Hapman Tubular Conveyors are dust-tight, odor-tight, liquid-tight—safely confining wet or dry, corrosive or non-corrosive, toxic, hygroscopic or other materials. With one drive, circuits operate in any plane or angle, dodge obstacles, pass through walls or narrow spaces.

**AS THE FIRST STEP** toward safer, lower-cost handling, write us, describing your application and requirements. We'll help compute potential savings.

REQUEST BULLETIN CE-155  
AND LIST OF FOODS OR  
CHEMICALS NOW HANDLED.

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DIVISION HAPMAN-DUTTON COMPANY

KALAMAZOO MICHIGAN

In British Commonwealth & Europe:  
Fisher and Ludlow Ltd., Birmingham

In Canada:  
Canadian Vickers Ltd., Montreal

#### FIRMS . . .

erection of a superphosphate plant.

**Cochrane Corp.**, Philadelphia, Pa., manufacturer of water-conditioning equipment has opened an office at 261 Madison Ave., New York.

**Superior Refining Co.** has put its new 1,000 b/d UOP platforming unit on stream in Superior, Wis.

**The Lunkenheimer Co.** has expanded its valve producing facilities in Cincinnati, Ohio.

**Pacific Oil & Refining Co.** will begin construction of a 10,000 b/d refinery in Tacoma, Wash., in March.

**Aluminum Ltd.** has expanded the capacity of its new smelter at Kitimat, B.C., by 60,000 tons of ingots/yr. at a cost of \$45 million.

**Gulf Oil Corp.** has begun the construction of one of four new catalytic reforming units in Pittsburgh, Pa.

**University of Dayton** plans to build a \$1 million building to house its chemistry and chemical engineering departments.

**Blaw-Knox Co.** has acquired all outstanding capital stock of Tri-Lok Co., Pittsburgh.

**General Paint Corp.**, San Francisco, plans a \$250,000 Pacific northwest district office in Portland, Ore.

**B. F. Goodrich Co.** will double the foam rubber productive capacity of its sponge products div. at Shelton, Conn., at a cost of \$3.5 million.

**Hudson Pulp Paper Corp.**, New York, plans a \$15 million addition to its Palatka, Fla., plant.

**American Hard Rubber Co.**, New York, will establish a \$1.5 million facility in western Arkansas.

**General Electric Co.** has established a new Communication Equipment Center in Redwood City, Calif.

**Garfield Chemical & Mfg. Co.** plan extensive storage facilities for sulfuric acid, in Grand County, Utah.

**Rietz Mfg. Co.**, Santa Rosa, Calif., has opened offices in Atlanta to service its chemical processing machinery.

**International Nickel Co.** has set up steel erections in the construction of its iron ore plant near Copper Cliff, Ont.

**The University of Texas Geology Fdn.** has received a \$750 grant from Standard Oil Co. of Texas.

**National Ammonia Co.** has bought du Pont's anhydrous ammonia facility in North Philadelphia, Pa.

**Rayonier, Inc.**, has established a 30,000 acre tree farm in the Pacific Northwest.

**Pure Oil Co.** plans to build a catalytic reforming unit at Smiths Bluff refinery in Texas.

**National Starch Products Inc.** has purchased a tract of land at Meredosia, Ill., for the construction of a second vinyl resin plant.

**International Salt Co.** has opened two new salt warehouses in Milwaukee and Detroit.

**Rockwell Mfg. Co., Meter & Valve Div.**, has opened a new district office in Shreveport, La.

**Tide Water Associated Oil Co.** has begun operation of its new distributing terminal at Dupont, Pa.

**General Foods** plans to construct an enlarged food research center in Tarrytown, N. Y.

**Wheeler Associates, Inc.**, Cleveland, has taken over Crouch Associates—operations research firm.

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with

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## ION EXCHANGE RESINS

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- Increased Yields
- Processing Shortcuts
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- Added Safety
- Lower Costs
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**AMAZING?** Yes, but these and other advantages are being obtained in reactions such as esterification, epoxidation, hydrolysis, etc. A technical bulletin, complete with literature survey, is yours for the asking.

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through Practical Applied Science

# AN EXPLANATION

*In answer to increased interest in a recently inaugurated procedure for conducting "on-the-spot" demonstrations of air-flotation equipment, we are pleased to make the following explanation.*

The advent of our lab-size Whippet V-80 Separator makes it possible to establish, in your own plant and at your convenience, accurate forecasts of results which will be obtained from the identical process under full-scale operating conditions.

*Such a demonstration may be of invaluable aid to that phase of your research program which involves the economy of operations and the quality of raw or end products. Perhaps the V-80 will indicate an immediate usefulness. Seeing is believing.*

Your move is simple. Write to the department and address below. Tell us that you want to see the results of separations made by effecting differences in specific gravity through air-flotation . . . under your actual operating conditions, rather than in a catalog. We'll take it from there.



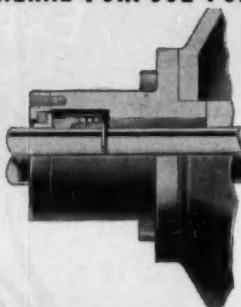
DEPT. C-155

SUTTON, STEELE & STEELE, INC.  
1031 SOUTH HASKELL, DALLAS, TEXAS

# VIKING

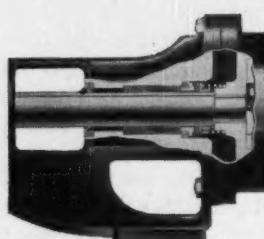
150

## GENERAL PURPOSE PUMPS



54

## HEAVY-DUTY PUMPS



### NOW AVAILABLE WITH MECHANICAL SEALS

General Purpose all-weather Viking Pumps in sizes from 20 to 200 G.P.M. and Heavy Duty Viking pumps in sizes from 10 to 300 G.P.M. can now be furnished with mechanical seals. The seals are packaged units with a minimum of parts and no chance for mis-assembly.



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CEDAR FALLS, IOWA

THE ORIGINAL "GEAR-WITHIN-A-GEAR" ROTARY PUMP

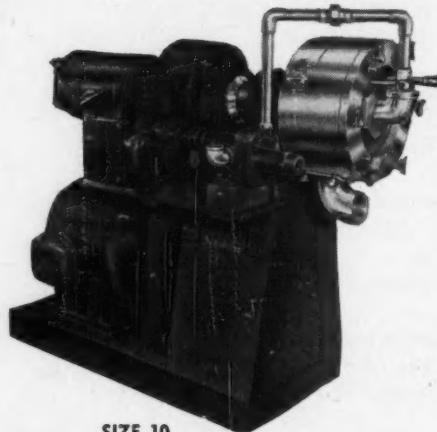
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for PIGMENT DISPERSIONS  
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WITH VARIABLE SPEED FEED PUMP

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### FURNISHED IN SIZES FOR ALL PRODUCTION QUANTITIES

SIZE 2 Laboratory (Vari-speed)  
1HP, 2 to 25 Gals. per Hr.

SIZE 4 Pilot Plant  
5HP, 10 to 30 Gals. per Hr.

SIZE 6 Medium Production  
10HP, 10 to 100 Gals. per Hr.

SIZE 8 Large Production  
15HP, 50 to 150 Gals. per Hr.

SIZE 10 Quantity Production  
20HP, 100 to 300 Gals. per Hr.

SIZE 12 Large Quantity Production  
30HP, 200 to 500 Gals. per Hr.

Larger Units up to 100HP for Unlimited Quantities.

Send today for Complete Catalog, Specifications and Price List

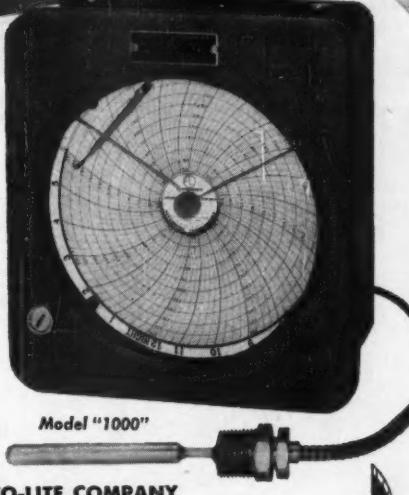
**TRI-HOMO CORPORATION**  
77 HIGHLAND AVE., SALEM, MASS.

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## TEMPERATURE RECORDING...

Newly designed, Model "1000" Auto-Lite Recorder gives permanent proof of temperature behavior. • 6" clear reading chart; various standard ranges from minus 40°F. to plus 550°F. • 3 standard types; choice of 24-hr. or 7-day cycle. • Electric or mechanical chart drive. • With capillary tubing for remote reading. Priced from \$49.50.

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Model "1000"

THE ELECTRIC AUTO-LITE COMPANY  
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## TEMPERATURE RECORDERS

You gotta be first...  
to be best!\*

\*25 years ago, Alloy Fabricators started to build Stainless Steel, Monel, Inconel, Nickel and Aluminum Process Equipment. With this experience, naturally, they're your best bet today!

It's Still Our Only Business  
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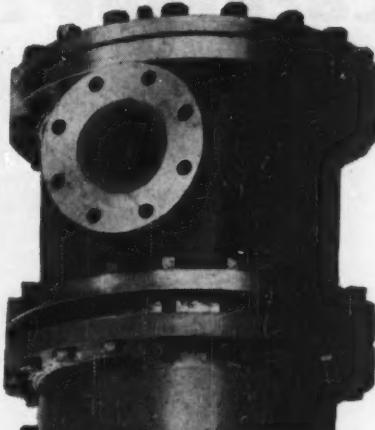


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DIVISION OF CONTINENTAL COPPER AND STEEL INDUSTRIES, INC.

PERTH AMBOY, NEW JERSEY

## heat exchangers BY Paracoil



provide sustained performance, rugged construction and an eye to operational accessibility for maintenance and repairs. We build well—our record of repeat orders from satisfied clients attests to that.

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Solvent Recovery Equipment  
• Extraction Coils • Evaporators • Reaction Vessels • Condensers (for any vapor)  
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Your pilot plant or special equipment requirements can be handled by our experienced staff of chemical and mechanical engineers. We solicit your inquiries.



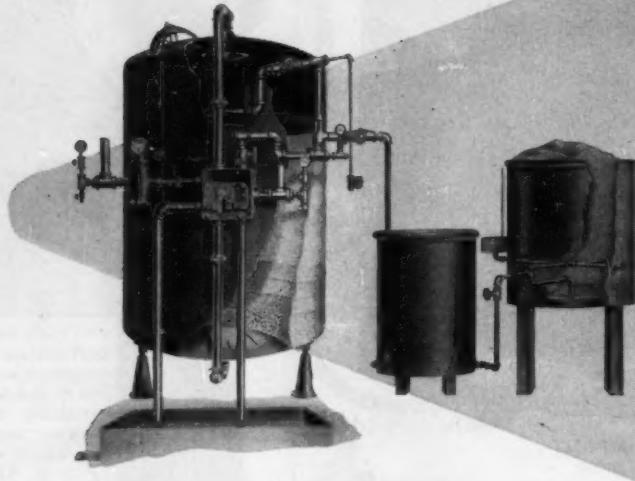
A stainless steel Reflux Condenser, floating head construction.

**DAVIS ENGINEERING**  
CORPORATION

1058 East Grand Street, Elizabeth 4, N. J.  
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## Cochrane ZEOLITE SOFTENERS provide easy, economical operation



The Cochrane Hydromatic Single Control Valve provides positive, accurate control of all phases of the softening and regenerating cycle.

It is so simple to operate that no technical knowledge of the softening process or the equipment is required. High quality effluent is thus assured at a minimum cost and maximum delivery.

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For complete details on Cochrane Zeolite Softeners, use the coupon below.

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Pottstown Metal Products Division—  
Custom built carbon steel, alloy and non-ferrous products.

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Send me a copy of Publication 4520-A on Zeolite Softeners.

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No amount of sweat and tears in a Detroit soap plant seemed to keep production moving smoothly. Arching soap chips clogged up the bins and hoppers and brought everything to a standstill.



That is, until a CLEVELAND vibrator was installed and got things back into full swing again.

There's no limit to the range of materials a CLEVELAND will move. Our detailed literature will describe the vibrator for your problem.

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**CLEVELAND VIBRATOR COMPANY**

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**WORRIED ABOUT  
WHERE TO PUT  
YOUR BOILER  
INSTALLATION?**

**The KANE VERTICAL  
BOILER PACKAGE  
IS YOUR ANSWER . . .**

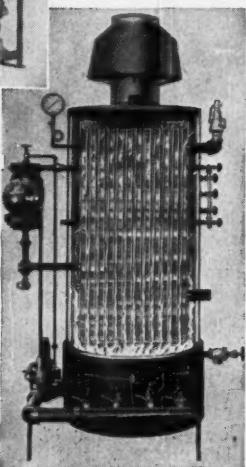
... chances are that floor space is at a premium in your shop or plant ... if so, you needn't be robbed of this valuable space by a cumbersome, horizontal type boiler ... not when a KANE vertical BOILER PACKAGE will give you the same or probably better results.

The KANE BOILER PACKAGE includes: the correctly sized Automatic Gas-Fired Boiler complete with gas burner and controls to maintain required steam pressure; and an M-K-O Automatic Boiler Feed system designed to return condensate and supply make-up water as required for highest operating efficiency.

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Full details in new KANE Bulletin, No. 2K.



The M-K-O Automatic Boiler Feed returns condensate and supplies make-up water as needed to the KANE boiler.

The KANE Boiler, built to A.S.M.E. specifications, in sizes to 30 H.P.



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DIVISION OF S.T. JOHNSON CO.  
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**"LIQUIDS WORTH STORING  
ARE WORTH  
MEASURING"**

with a

**LIQUIDOMETER**

*Tank Gauge*

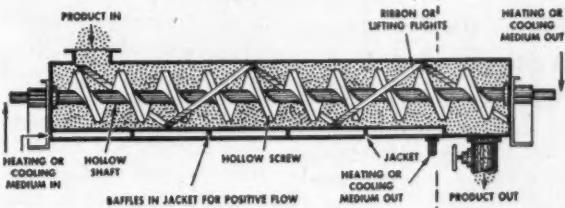
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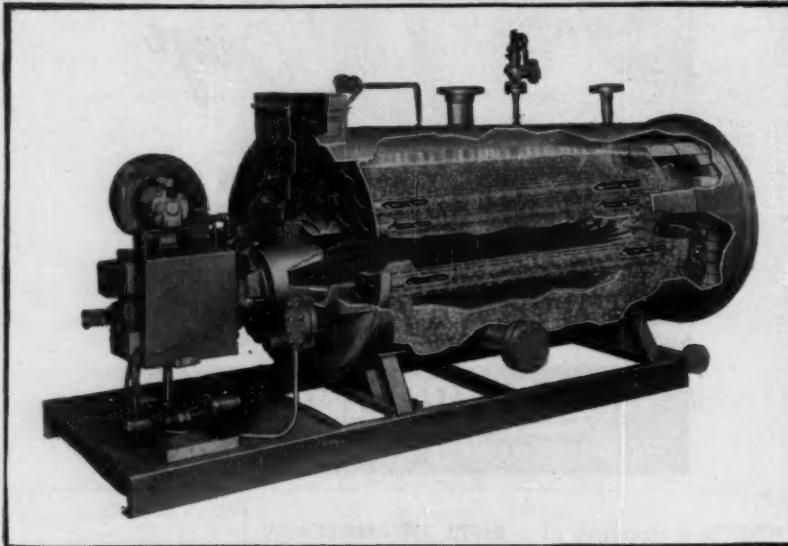


# Burning Issues

Eclipse

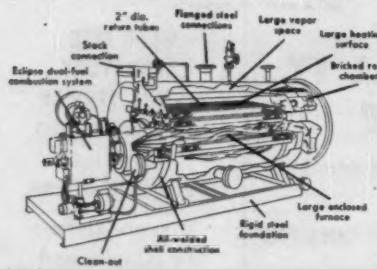
Published by Eclipse Fuel Engineering Company  
Rockford, Illinois

The "fire tubes" make Eclipse Dowtherm Vaporizers  
safer and more economical to operate!



## Eliminate explosion hazards caused by tube deposits

In the fire tube vaporizer, heat is transferred from the tubes and the large enclosed furnace to the surrounding liquid . . . there's no pump-



## DOWTHERM MANUAL



System layouts, complete descriptions of vertical and horizontal Dowtherm Vaporizers, accessories, engineering data, and specifications. Write for Bulletin A-100.

ing of dowtherm through heated coils . . . no danger of carbon building up inside the tubes. Impurities settle in the sludge area and cannot be baked onto heating surfaces or circulated through the vaporizer. *Vigorous natural circulation* increases heat transfer efficiency and keeps vital heat exchange surfaces constantly clean. There is no local overheating or "climbing" of vapor pressure . . . no expensive maintenance. These are reasons why insurance company rates are 1/3 less for Eclipse Dowtherm Vaporizers than for any other design—because fire and explosion hazards are minimized. There are other important considerations, too. Proper size-capacity relationships have been maintained for maximum performance and efficiency against the general trend to "streamline." Large combustion area assures high heat output without "pushing" or strain—lower BTU per cubic foot of heating space. All heating surfaces are below the liquid level, protecting tubes from burning and increasing efficiency. Large vapor space eliminates priming. Horizontal and vertical types available — capacities to 4,000,000 BTU/hr.



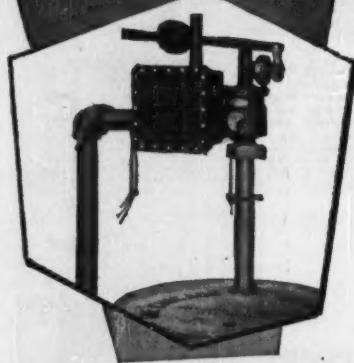
## A NEW AUTOMATIC VALVE

TO SOLVE YOUR TANK OR DRUM FILLING PROBLEMS



## THE DAVIS

No. 97TH SOLENOID VALVE  
SAVES TIME  
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Here is the solution to your container filling problems. It is the DAVIS two-step solenoid valve especially designed for accurate weighing and filling. No more guesswork, no more spillage, no more waste. You get faster filling that always keeps step with production. This valve is ruggedly built to withstand years of hard service. Standard or explosion-proof housing available. No matter what liquids you are handling, DAVIS can meet your need, giving you the most efficient, economical operation possible.

Send for this new Bulletin 700 describing Davis' complete line of solenoid operated valves.



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ECLIPSE FUEL ENGINEERING CO. OF CANADA, LTD., TORONTO, ONTARIO



# The best way to get the most for your tube steel dollar: Ask the experts!

This month's report is on:

## 2% CR.-MO.

Has intermediate corrosion resistance in combination with good creep strength and fair resistance to oxidation. For use at temperatures up to 1200°F. in cracking coils, reforming units, heat exchangers, vapor line and hot oil piping, and return-bend forgings for oil heaters.

| ONE OF 24 TIMKEN HIGH TEMPERATURE STEELS |                  |                |           |
|--|------------------|----------------|-----------|
| Carbon                                   | Sicromo 2        | Sicromo 5S     | 18-8Ti    |
| Carbon-Mo.                               | Sicromo 2½       | Sicromo 5MS    | 16-13-3   |
| DM-2                                     | 2½% Cr.-1% Mo.   | Sicromo 7      | 25-20     |
| Silmo                                    | Sicromo 3        | Sicromo 9M     | 25-12*    |
| DM                                       | 4-6% Cr.-Mo.     | 18-8 Stainless | 35-15**   |
| 2% Cr.-Mo.                               | 4-6% Cr.-Mo.-Ti. | 18-8 Cb        | 16-25-6** |

\* Available as seamless tubing on an experimental basis only.

\*\* Not available as seamless tubing.

THERE are probably several high temperature tube steels that will solve your heat, pressure, corrosion or oxidation problems. But there's only one that will give you the most for your tube steel dollar—the best life/cost ratio.

The best way to find it is to ask Timken Company metallurgists. They're recognized authorities on high temperature steels. With 23 years of experience behind them, they can help you select your best steel from 24 different analyses. You'll be sure of getting the most for your tube steel dollar. And you'll be assured of uniform quality in every tube because The Timken Company rigidly controls quality from melt shop through final inspection.

For help with your tube steel problems, *ask the experts!* The Timken Roller Bearing Company, Steel & Tube Division, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".



This photo shows final tube inspection—last of hundreds of rigid tests that help account for the uniform quality of Timken high temperature steels.

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH



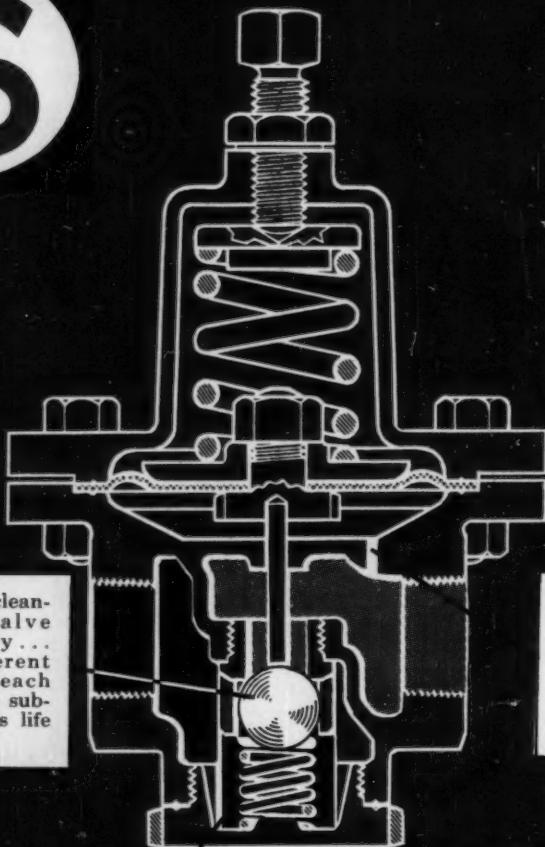
SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING  
CHEMICAL ENGINEERING—January 1955

# THE LATEST CASH STANDARD VALVE

## TYPE 1260

C  
S

*Direct Operated • Self Contained • Single Seat  
Pressure Reducing and Regulating*



Spherical self-cleaning inner valve rotates freely... seats in different positions at each closure, adding substantially to its life expectancy.

New large area built-in strainer.

### WITH EXCLUSIVE DESIGN\* for...

- Extremely LOW PRESSURE DROP and LOCKUP
- MINIMUM SIZE and WEIGHT with MAXIMUM SENSITIVITY
- LOWER INITIAL COST
- LONGER LIFE
- EASY SERVICING without removing from pipeline
- UNIVERSAL APPLICATION: water, gas, steam, air, oil & other non-corrosive fluids
- 300 psi INLET PRESSURE ... 3 to 250 psi DELIVERED PRESSURE

Velocity of gas or liquid passing the body port creates suction, thus reducing pressure in lower diaphragm chamber and opening valve wider to produce lower pressure drop.

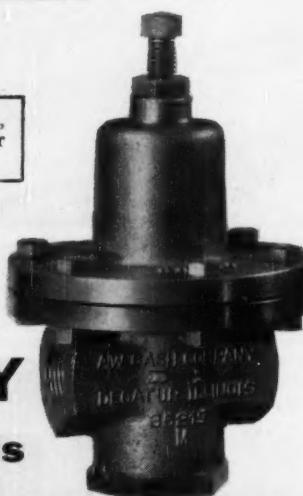
\*patent applied for

Available in aluminum, bronze, iron, steel or other specified materials.

WRITE TODAY FOR NEW BULLETIN

**A. W. CASH COMPANY**

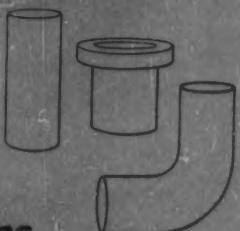
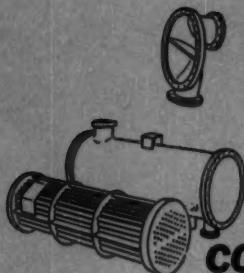
P. O. Box 551 • Decatur, Illinois



PRESSURE, HYDRAULIC, TEMPERATURE, PROCESS AND COMBUSTION CONTROLS

*An announcement*  
*to the... Chemical, Petrochemical,*  
**Petroleum and Related Process Industries**

**ALCOPLATE\***



**is now available for solving your  
CORROSION and CONTAMINATION problems**

Any chemical, petroleum, petrochemical or other process company faced with contamination or corrosion problems now has a significant opportunity for cost reduction.

Chemical nickel-plating by the "Kanigen"® process — announced only a year and a half ago — now is in volume operation at ALCO after thorough documentation proved without question its superior advantages. ALCO calls its application ALCOPLATE, a term that includes important pre-plating and post-plating operations, experimentation and laboratory testing, as well as the chemical plating process itself.

ALCOPLATE provides a protective nickel coating of uniform thickness, with zero porosity and excellent chemical resistance. When applied to inexpensive basis metals, it gives at least the same protective qualities as pure nickel or high-priced corrosion-resistant alloys.

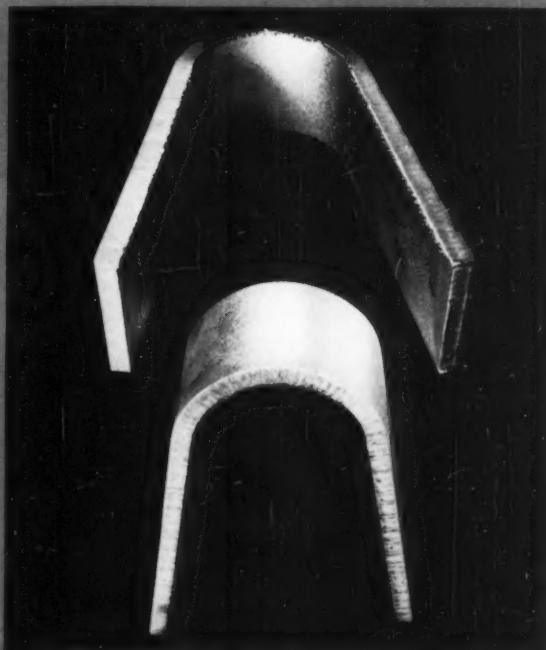
ALCOPLATE will pay for itself many times over through prolonged life of process and transmission equipment subject to corrosive attack. In addition, important basic savings will result from materials in process being kept free of contamination.

As the company which has fabricated and plated the vast majority of nickel-plated pipe installed in atomic energy producing plants for gaseous transmission purposes, ALCO ranks as the most experienced producer of industrial nickel-plated equipment. Based on extensive research, ALCO has constructed a major process facility plus a completely equipped physical and metallurgical laboratory for research and development of the ALCOPLATE process.

For the present, ALCOPLATE is offered principally for process industry applications. To such companies, ALCO's test plant and laboratory facilities are available without obligation to determine the practicalities of ALCOPLATE for specific applications. Plant inspection of the ALCOPLATE process is invited.

\*ALCOPLATE — Trade-mark registration applied for.

®"KANIGEN" is a mark identifying chemical deposition of high-nickel, low-phosphorus alloy by General American Transportation Corporation and its licensees, and the coating resulting therefrom.



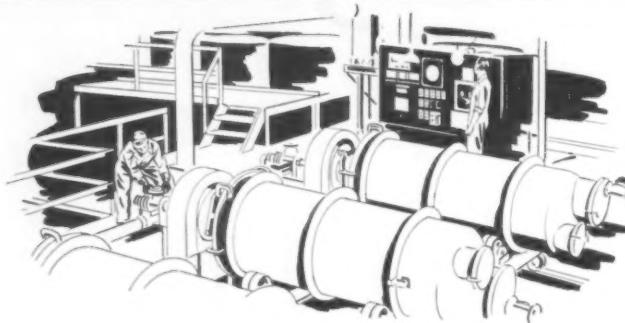
*Unretouched photograph (note unfinished edges) of test specimens with ALCOPLATE coating applied in flat condition, after being reverse bent 180° about a 1 in. radius, showing complete absence of flaking or spalling of plated surface. This is but one of many tests typical of the high degree of quality control that is routine at ALCO.*

**ALCO**  
AMERICAN LOCOMOTIVE COMPANY

FOR MORE FACTS ON ALCOPLATE TURN THE PAGE

# Here are the outstanding features of **ALCOPLATE\***

for solving your **CORROSION** and **CONTAMINATION** problems



**1. Zero Porosity** is assured with plating thicknesses of half mil (.0005") or more. This means 100% product protection at minimum plating cost.

**2. Adhesion** is outstanding. Plated steel specimens show no flaking or spalling when reverse bent 180° or pulled to the yield point of the steel.

**3. Uniformity** of thickness varies less than 10% from the average on *any* surface, including, corners, threads, blind holes, etc. Costly over-plating is eliminated.

**4. Hardness** is excellent, averaging 500 Vickers (48 Rockwell C). Post-plating heat treatment increases hardness to 950 Vickers (66 Rockwell C).

**5. Corrosion Resistance** is at least equal to and generally superior to that of pure nickel . . . due to the phosphorous content of the deposit.

**6. Cost is Lower** for ALCOPLATE than for conventional nickel plating, or for equipment made from wrought nickel or nickel-clad material. Its quality and uniformity mean sizable savings of nickel.

#### **ALCO Invites Your Thorough Investigation**

Write ALCO, Box 1065, Schenectady, New York,  
for a copy of the new product bulletin on ALCOPLATE.

# ALCO

AMERICAN LOCOMOTIVE COMPANY

#### Consult your ALCO Sales and Engineering Representative at:

|                       |                              |
|-----------------------|------------------------------|
| BEAUMONT, TEX.        | 1400 Crockett Street         |
| CHICAGO, ILL.         | 909 McCormick Building       |
| CLEVELAND, OHIO       | Terminal Tower Building      |
| HOUSTON, TEX.         | 1404 Dunlavy Street          |
| KANSAS CITY, MO.      | 606 Commerce Trust Bldg.     |
| LOS ANGELES, CALIF.   | 3035 East 46th Street        |
| NEW YORK, N. Y.       | 30 Church Street             |
| PITTSBURGH, PA.       | 527 Frick Building           |
| ST. LOUIS, MO.        | 4050 Bingham Avenue          |
| ST. PAUL, MINN.       | 635 Prior Ave. N.            |
| SAN FRANCISCO, CALIF. | 235 Montgomery St.           |
| TULSA, OKLA.          | 200-206 North Delever Street |
| WASHINGTON, D. C.     | 910 17th Street, N.W.        |

# Let's face it!

## HAVE YOU A DISASTER PLAN FOR YOUR PLANT?

### BOMBS...OR FIRE...OR FLOOD...OR TORNADO ...you can handle them if you act now.

Let's face it...the threat of war and the atomic bomb has become a real part of our life—and will be with us for years. Fires, tornadoes and other disasters, too, can strike without warning.

Whatever the emergency is, everybody's going to want help at the same time. It may be hours before outside help reaches you. The best chance of survival for you and your workers—and the fastest way to get back into production—is to know what to do and be ready to do it. Disaster may happen TOMORROW. Take these simple precautions TODAY:

**Call your local** Civil Defense Director. He'll help you set up a plan for your offices and plant—a plan that's safer, because it's integrated with community Civil Defense action.

**Check contents** and locations of first-aid kits. Be sure they're adequate and up to date. Here, again, your

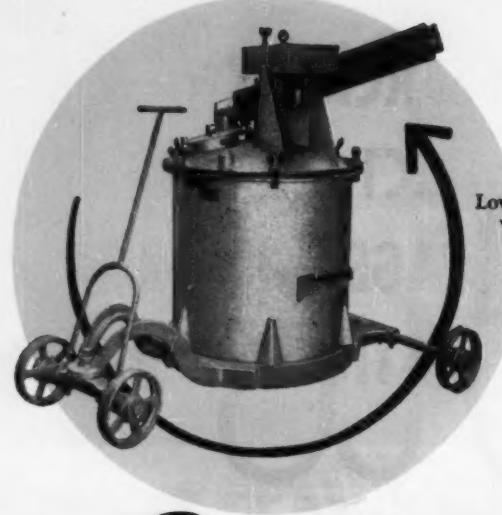
CD Director can help. He'll advise you on supplies needed for injuries due to blast, radiation, etc.

**Encourage personnel** to attend Red Cross First-Aid Training Courses. They may save your life.

**Encourage your staff** and your community to have their homes prepared. Run ads in your plant paper, in local newspapers, over TV and radio, on bulletin boards. Your CD Director can show you ads and official CD films or literature that you can sponsor locally. Set the standard of preparedness in your plant city. There's no better way of building prestige and good community relations—and no greater way of helping America.

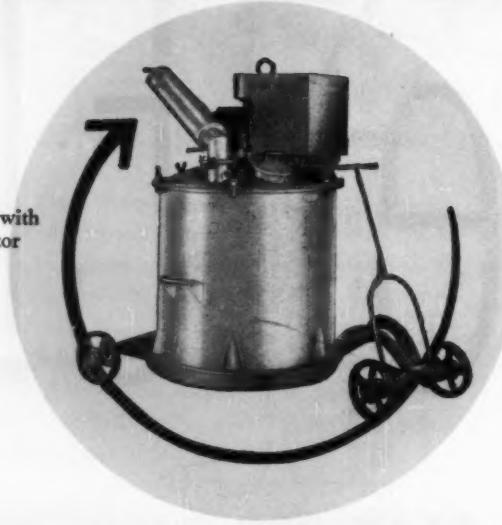
*Act now...check off these four simple points...before it's too late.*





Low-Boy  
with air motor

# drives



Low-Boy with  
electric motor

## ...to increase your production

The type of drive on a kettle should tie-in with your product's needs. Now . . . Brighton offers you a choice of air motor or electric motor drive. If you require infinite variations of speed, the air motor drive will give agitator blade peripheral velocities anywhere between 0 and 750 ft./min. Valve throttle device sets and maintains any speed within this range. If standard speeds will meet your production requirements, you'll want the electric variable-speed motor, driving a turbine-type agitator, with your Low-Boy Kettle.

Whatever your choice of drives, the Low-Boy, available in capacities up to 750 gallons, is your answer to fast, economical synthetic resin production right in your own plant. Write today for comprehensive bulletin describing all features.



**BRIGHTON** copper works inc.

820 state ave. • cincinnati 4 • ohio

DIVISIONS: F. C. DECKEBACH SONS CO., HAMILTON COPPER & BRASS WORKS

est. 1914 • engineers • metalsmiths • machinists • designers, producers of chemical processing equipment

Dept. H

**4 GOOD  
REASONS**  
for specifying

**DARNELL  
CASTERS & WHEELS**

### RUBBER TREADS...

a wide choice of treads suited to all types of floors, including Darnelloprene oil, water and chemical-resistant treads, make Darnell Casters and Wheels highly adapted to rough usage

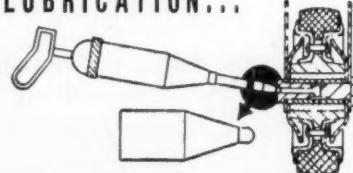
### RUST-PROOFED...

by the Udyline process, Darnell Casters give longer, care-free life wherever water, steam and corroding chemicals are freely used.

### STRING GUARDS...

Even though string and ravelings may wind around the hub, these string guards insure easy rolling at all times.

### LUBRICATION...



all swivel and wheel bearings are factory packed with a high quality grease that "stands up" under attack by heat and water. Zerk fittings are provided for quick grease-gun lubrication.





**How to keep  
informed on  
the "with what"  
part of  
your business**

AT YOUR FINGER TIPS, issue after issue, is one of your richest veins of job information—advertising. You might call it the "with what" type—which dovetails the "how" of the editorial pages. Easy to read, talking your language, geared specifically to the betterment of your business, this is the kind of practical data which may well help you do a job quicker, better—save your company money.

Each advertiser is obviously doing his level best to give you helpful information. By showing, through the advertising pages, how his product or service can benefit you and your company, he is taking his most efficient way toward a sale.

Add up all the advertisers and you've got a gold mine of current, on-the-job information. Yours for the reading are a wealth of data and facts on the very latest in products, services, tools . . . product developments, materials, processes, methods.

You, too, have a big stake in the advertising pages. Read them regularly, carefully to keep job-informed on the "with what" part of your business.

**McGRAW-HILL  
PUBLICATIONS**



- **RESEARCH MEN**
- **PROJECT ENGINEERS**
- **MANAGEMENT MEN**
- **OPERATION GROUPS**

*Call on*  
**PROCTOR &  
SCHWARTZ**

**to gain advantages of an organization  
with largest aggregate of**

**"EXPERIENCE YEARS"**

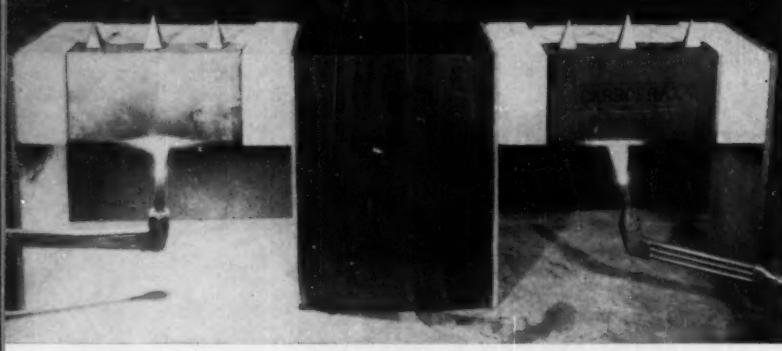
**in application of drying equipment  
in the chemical industry**

PROCTOR equipment is at work in all branches of the process industries: heavy chemicals, pharmaceuticals, plastics, foods, leather, synthetic textiles, rubber manufacturing, glue and gelatin, and many other related industries.

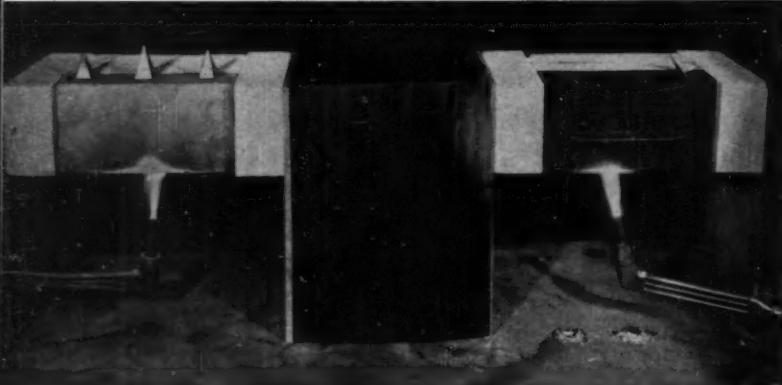
**PHONE MICHIGAN 4-6400 OR WRITE**

**PROCTOR & SCHWARTZ INC.**

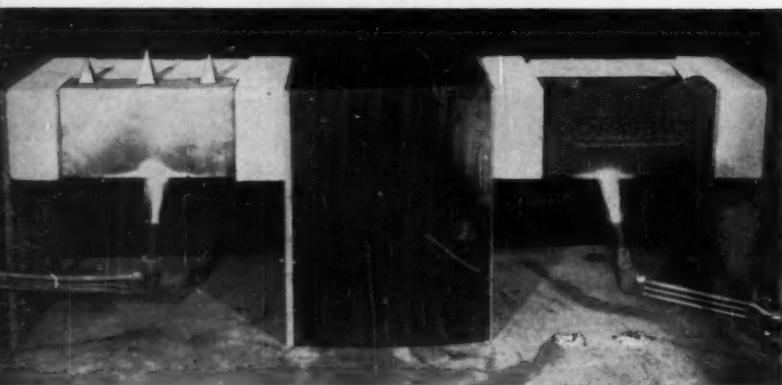
**711 TABOR ROAD  
PHILADELPHIA 20, PA.**



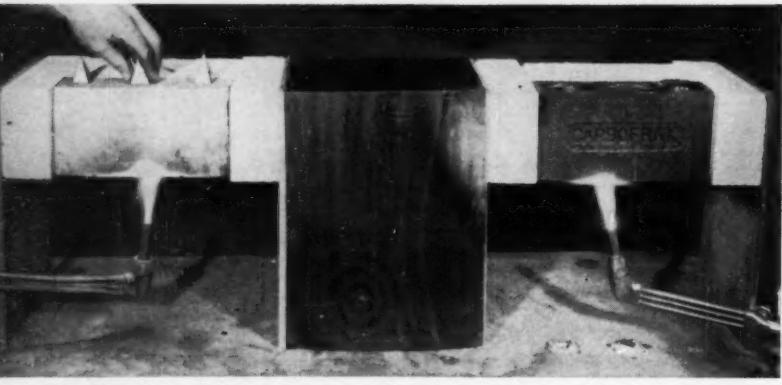
1 Which lead pyramids will melt first? Those on the fireclay brick (left), or those on the CARBOFRAX brick?



2 In minutes, heat passes through the CARBOFRAX brick... melts the first sinker... now melts the second.



3 Here, the third sinker melts... despite angle of the torch.



4 Minutes later, the sinkers on the fireclay brick are still cool enough to touch.

# HOW TO MOVE MORE HEAT FASTER...

Here is visual proof of how much faster you can transmit heat through a CARBOFRAX® silicon carbide refractory than through fireclay. By test, 11 to 12 times faster...or about the same rate of heat transfer you get with chrome nickel steel.

When you move heat this fast...

**...you save time.** You reach operating temperatures faster. And you can quickly shift furnaces and process equipment from one temperature level to another.

**...you get better results.** This kind of heat conductivity gives you better heat distribution...closer quality control...increased production.

**...you cut fuel costs.** It takes less fuel to reach operating temperature...less fuel to stay there.

...you can also dissipate heat more rapidly. This is why CARBOFRAX refractories are used for set kettles, arc shields, stills and similar applications.

## Test also proves CARBOFRAX refractories resist intense heat!

The torch blasted a 1½" hole into the fireclay—yet it had no effect on the CARBOFRAX brick. A striking example of the latter's heat resistance and long-wearing qualities.

For more information write or phone us for your free copy of "Super Refractories." Address Dept. H15, Refractories Division, The Carborundum Company, Perth Amboy, N. J.

**CARBORUNDUM**  
Registered Trade Mark



## he's working for you

THIS FELLOW IS TRAINED IN YOUR BUSINESS. His main duty is to travel the country — and world — penetrating the plants, laboratories and management councils . . . reporting back to you every significant innovation in technology, selling tactics, management strategy. He functions as your all-seeing, all-hearing, all-reporting business communications system.

THE MAN WE MEAN IS A COMPOSITE of the editorial staff of this magazine. For, obviously, no one individual could ever accomplish such a vast business news job. It's the result of many qualified men of diversified and specialized talents.

AND, THERE'S ANOTHER SIDE TO THIS "COMPOSITE MAN," another complete news service which complements the editorial section of this magazine — the advertising pages. It's been said that in a business publication the editorial pages tell "how they do it" — "they" being all the industry's front line of innovators and improvers—and the advertising pages tell "with what." Each issue unfolds an industrial exposition before you — giving a ready panorama of up-to-date tools, materials, equipment.

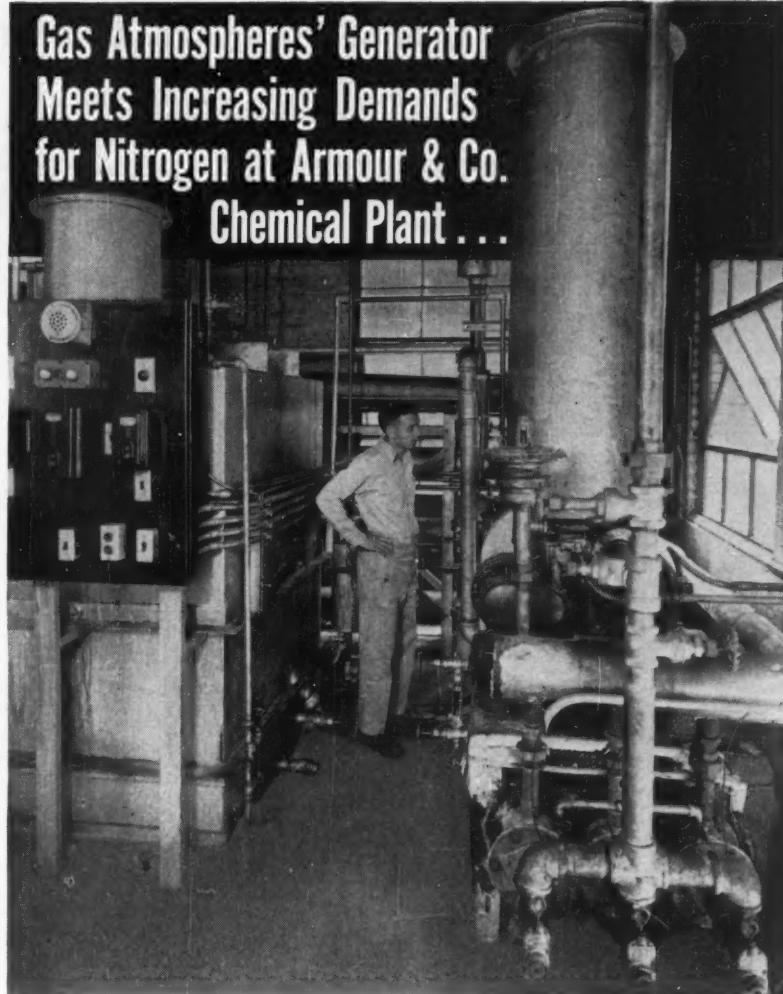
SUCH A "MAN" IS ON YOUR PAYROLL. Be sure to "listen" regularly and carefully to the practical business information he gathers.



### McGRAW-HILL PUBLICATIONS

CHEMICAL ENGINEERING—January 1955

## Gas Atmospheres' Generator Meets Increasing Demands for Nitrogen at Armour & Co. Chemical Plant . . .



### EXPANSION, NEW USES SATISFIED BY ADDING STORAGE FACILITIES

● A few years ago Armour & Co. purchased a Gas Atmospheres' Nitrogen Gas Generator for use in their McCook Chemical Division installation. Today they're glad they did.

The reason: the use of nitrogen gas has been on the constant increase and the Gas Atmospheres' unit has met these greater needs unfailingly. Because of variable demand, they're now considering adding storage facilities in order to get even greater utilization from the units.

Some of the many Armour uses: flushing thousands of feet of lines where steam or air would introduce water or oxygen into the product; blanketing acetone; purging hydrogen gas production unit; for the gaseous element in manometer operation.

Armour engineers working with the unit, which is equipped with both refrigerant and chemical dryers, say it is a most dependable piece of equipment.

If you want long-term results like these, it will pay you to talk today with a Gas Atmospheres' engineer.

**gas Atmospheres, inc**  
equipment for producing industrial gases  
20011 WEST LAKE ROAD — CLEVELAND 16, OHIO

# SPECIAL . . . for chlorine service

## OIC 600-LB. FORGED STEEL, O. S. & Y. VALVES

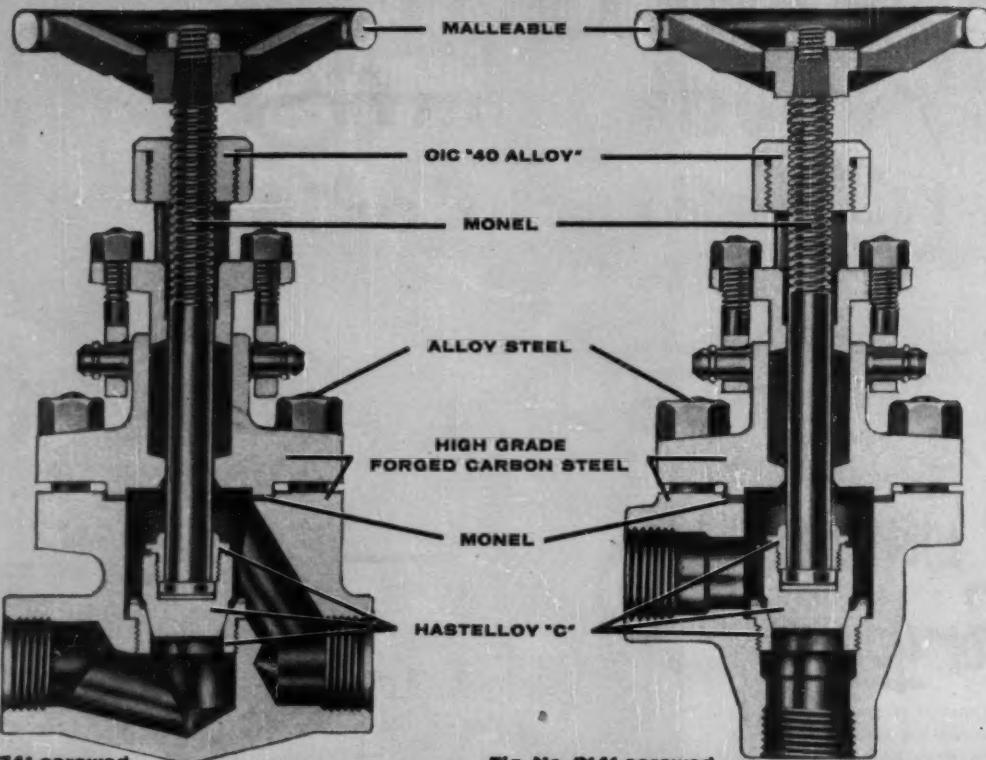


Fig. No. 1741 screwed  
Fig. No. 1740 flanged

Fig. No. 2141 screwed  
Fig. No. 2140 flanged

Proper design and the correct choice of metals combine in this OIC Forged Steel line to assure adequate strength, safety, and long trouble-free operation on chlorine service.

**Hastelloy "C"** swivel nut—disc—seat ring—Resist corrosive action of chlorine, increasing service life.

**Monel stem**—body-bonnet gasket—The monel stem resists corrosion. It is of generous size and accurately machined for ease of operation. The soft monel gasket is ideal for chlorine service.

**OIC "40 Alloy"** yoke bushing—"40 Alloy" is an aluminum-silicon-bronze which will not corrode, gall or seize. Its use adds to the ease of operation and increases the valve's service life.

**High-Grade Forged Carbon Steel** pressure parts—Amply proportioned wall thicknesses throughout provide strength and safety.

**Alloy Steel Bolting** 4 bonnet studs—Of proper

size and quality to assure safety and ruggedness at the joint.

**Malleable** handwheel—Heavy and large, shaped for non-slip gripping.

Packing is resistant to the corrosive action of chlorine. A back seating arrangement permits repacking in a full open position.

A wide seating surface of 30° included angle permits close flow regulation. Each valve is carefully inspected at assembly, and tested at 300 psi air under water.

Write for Bulletin No. 1000, which describes these valves more fully. It also contains information on valves for black, green and white liquor services. Request also Bulletin No. 195, which describes the redesigned OIC line of Forged Steel Gate Valves.

Contact your nearby OIC Distributor for all your valve needs.



# VALVES

FORGED & CAST STEEL, LUBRICATED PLUG,  
BRONZE & IRON

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

# How external lubrication is eliminated in **Leslie** **diaphragm control valves'** **new packing design**

The new Leslie Lubrisoft® Packing now standard in all Leslie Diaphragm Control Valves is recommended for valve body temperatures up to 500° F. without external lubrication. When used with the Leslie thermo-isolating bonnet, it may be used for valve body temperatures up to 1050° F., eliminating need for external lubricators and isolating valves in most applications.

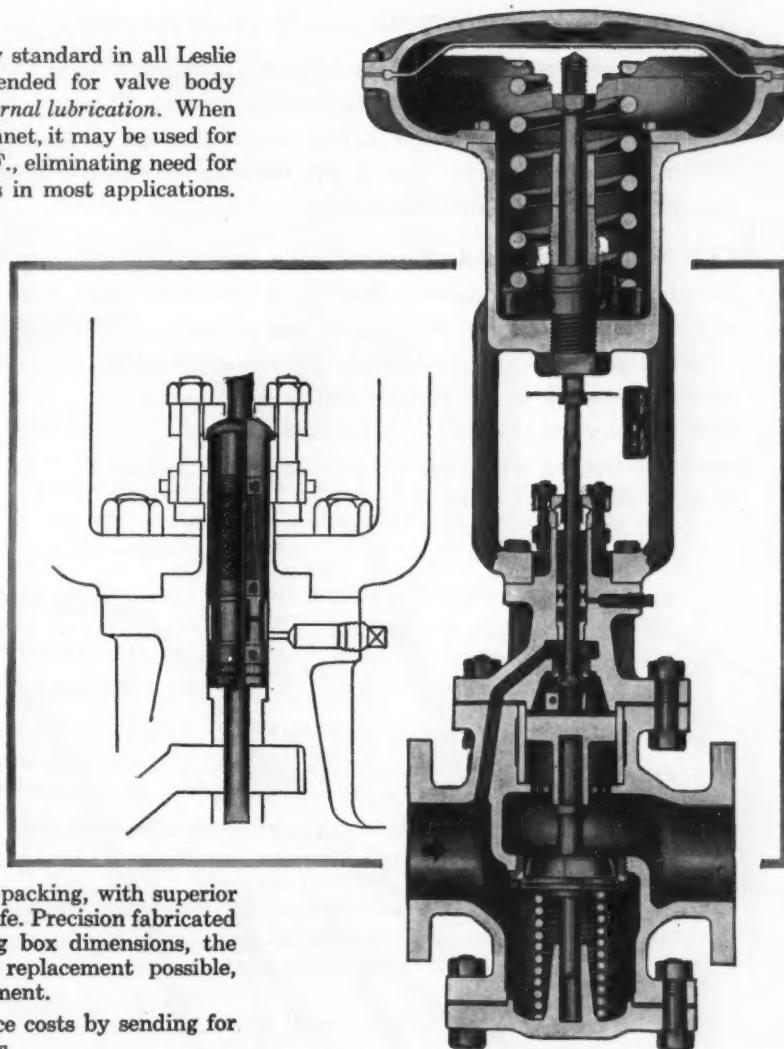
## **LESLIE LUBRISOFT® PACKING MEETS ALL 8 MOVING STEM SEAL REQUIREMENTS**

Each of the several types of Lubrisoft split ring packing is specifically designed to maintain the low-friction stem seal against one or more of these deteriorative service conditions:

1. Internal pressure, temperature and fluid
2. Contamination
3. Corrosion
4. Electrolytic Action
5. Oxidation
6. Extrusion
7. Abrasion
8. Friction

Overall result is a standard, economical packing, with superior stem sealing properties and long service life. Precision fabricated to conform exactly to the deep stuffing box dimensions, the positive, split ring design makes fast replacement possible, without disturbing body or stem adjustment.

Plan to reduce control valve maintenance costs by sending for Bulletin 5304 Diaphragm Control Valves.



**LESLIE CO., 279 GRANT AVENUE • LYNDHURST, NEW JERSEY.**

**TRADE  
MARK**  
**LESLIE CONTROL VALVES**

**"STILL FAR AHEAD IN QUALITY AND PERFORMANCE"**

# how to leap-frog your way

**They fly mighty high!** Economists get dizzy trying to catch up with the Chemical Process Industries. New products! More volume! New markets! Expansion and change! But what a king-size opportunity it builds up for the seller.

**Your competition's jumping!** Literally swarming all over the field as CPI operators stretch for an eye-popping \$70 billion-a-year output by 1960. Chemicals, conveyors, containers! Motors, mixers, instruments! Makers of equipment, raw materials producers, servicers! They're bustin' their brief cases to give the chemical engineer extra attention here in industry's fastest-moving market.

**CE's helping.** Buyer and seller both got a boost last month when **CHEMICAL ENGINEERING** launched its *Annual Inventory Issue*. This brand-new bench mark for CPI publishers was a smash-hit first trip out. Timely, unduplicated, wholly practical . . . it's a 12-months sourcebook of salient process developments, cut to the reader's own specifications. And it's got all the makin's . . . as a customer-stopping supermarket that'll push your product in his plant all year round.

**How can it miss?** It's such a logical added service, so long-wanted, so natural in format and content.

And CE's editors make it easy . . . reading matter easy to scan, easy to digest . . . ads easy to spot; a cinch to follow up for more information.

Bingo! Right at your fingertips is the permanent showroom for your full line every heads-up CPI advertiser has been looking for.

Did we say leap-frog? We meant it! It'll add impetus to your selling that'll keep those CPI orders hopping.

But don't wait'll next September . . . *Put the Inventory Issue on your CE schedule right now!*

Nothing like making sure of that extra surge of high-readership, low-cost advertising. You can't buy it anywhere . . . but **CHEMICAL ENGINEERING**.



**CHEMICAL PROCESS INDUSTRIES**

# to new CPI business

can you use these CPI selling tools?

**CONSULTING ENGINEERS** is just off the press with a close-up of these important CPI buying influences. 16 page booklet details areas of operation, volume, purchasing power . . . based on a comprehensive survey among top-flight engineering firms.

**HOW TO BEEF UP RAW MATERIALS SALES** is another 16-pager built around a 1954 study of chemicals salesmen. Covers market size—selling methods—what the chemical engineer buys—how to appeal to him in your ads.

**THE CHEMICAL PROCESS INDUSTRIES:** Here's the breakdown every CPI marketer needs to set quotas and potentials . . . distribution by industry, size, states, metropolitan areas . . . from the latest McGraw-Hill Census.

**ASK YOUR CE MAN** to show you a copy of this year's Annual Inventory Issue. Ask him, too, for specific facts on process applications for your product. Or, for the complete CPI Data File, just write to CE's Research Dept.

more engineering-minded

production men read it . . .

more advertisers

invest more pages in it . . .

# Chemical Engineering

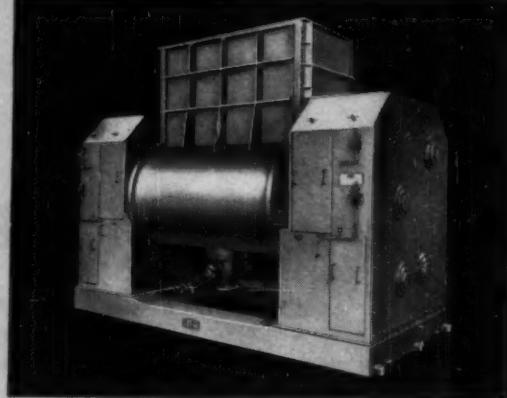
A McGRAW-HILL PUBLICATION, 330 WEST 42ND STREET, NEW YORK 36, N.Y.





# IN THE Paper Industry

**Read Standard supplies leading manufacturers with the equipment they need for rapid dispersion of ingredients in preparation of high density coatings**



The Unique bowl construction of Readco Mixers greatly multiplies their effective mixing areas . . . reducing the length of the mixing cycle and resulting in consistently high rates of production. For complete information, write to Bakery-Chemical Division, York, Pennsylvania.

**READ STANDARD**  
CORPORATION

Read Standard also manufactures a complete line of positive displacement Blowers and Vacuum pumps for industrial use. For information write, Read Standard Corp., York, Pennsylvania.

BAKERY-CHEMICAL DIVISION  
York, Pennsylvania  
Los Angeles 29, California

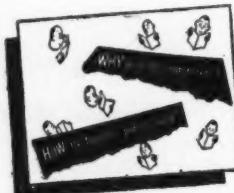


**All business is specialized**  
*... and nothing specializes on your business like your business paper*

This profit-wise peddler looks for the wettest crowds. His business is specialized. Like yours.

And like your business, this business paper of yours specializes, too. It packs into one place the current facts you want. It scouts out, sorts out, reports and interprets the specific news and information you need to keep posted and keep ahead in your field. Cover to cover, editorials and ads, it concentrates on bringing you specialized help you can't get anywhere else. Read it thoroughly . . . and put it to work.

This business paper in your hand has a plus for you, because it's a member of the Associated Business Publications. It's a paid circulation paper that must earn its readership by its quality . . . And it's one of a leadership group of business papers that work together to add new values, new usefulness, new ways to make the time you give to your business paper still more profitable time.



A copy of this quick-reading, 8-page booklet is yours for the asking. It contains many facts on the benefits derived from your business paper and tips on how to read more profitably. Write for the "WHY and HOW booklet," Room 2710.

**McGRAW-HILL PUBLISHING COMPANY**  
330 W. 42nd St., New York 36, N. Y.

One of a series of ads prepared by  
THE ASSOCIATED BUSINESS PUBLICATIONS





## he's working for you

THIS FELLOW IS TRAINED IN YOUR BUSINESS. His main duty is to travel the country — and world — penetrating the plants, laboratories and management councils . . . reporting back to you every significant innovation in technology, selling tactics, management strategy. He functions as your all-seeing, all-hearing, all-reporting business communications system.

THE MAN WE MEAN IS A COMPOSITE of the editorial staff of this magazine. For, obviously, no one individual could ever accomplish such a vast business news job. It's the result of many qualified men of diversified and specialized talents.

AND, THERE'S ANOTHER SIDE TO THIS "COMPOSITE MAN," another complete news service which complements the editorial section of this magazine — the advertising pages. It's been said that in a business publication the editorial pages tell "how they do it" — "they" being all the industry's front line of innovators and improvers—and the advertising pages tell "with what." Each issue unfolds an industrial exposition before you — giving a ready panorama of up-to-date tools, materials, equipment.

SUCH A "MAN" IS ON YOUR PAYROLL. Be sure to "listen" regularly and carefully to the practical business information he gathers.



**McGRAW-HILL PUBLICATIONS**

CHEMICAL ENGINEERING—January 1955

# FIGHT FIRE FAST!

## WITH A KIDDE CO<sub>2</sub> SYSTEM!

Let fire get a foothold, and a going concern is gone. Don't risk it. Install a Kidde Automatic CO<sub>2</sub> Fire Extinguishing System, and fire won't stand a chance.

A Kidde System goes into action at the first sign of fire —releases clouds of CO<sub>2</sub> over the blaze, smothers fire almost as soon as it starts. And CO<sub>2</sub> leaves no mess to clean up later. It puts out the fire, then vanishes.

Protect flammable liquids, machinery and electrical equipment with a Kidde System.

And for on-the-spot protection, get Kidde portables. When fire strikes, just aim the horn, pull the trigger, and swoosh! No more fire.

Don't wait 'til your business is a cinder pile—Contact Kidde today.

# Kidde

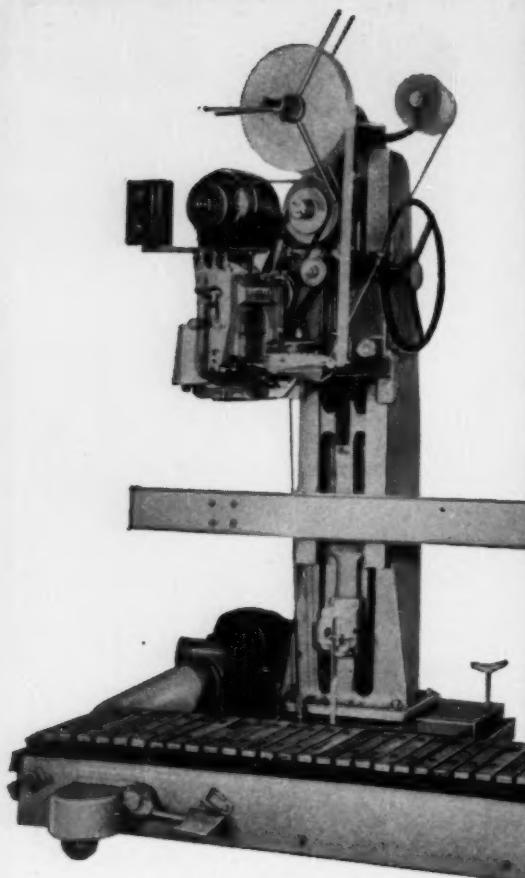
Walter Kidde & Company, Inc.

128 Main Street, Belleville 9, New Jersey

Walter Kidde & Company of Canada, Ltd., Montreal—Toronto

The words 'Kidde', 'Lux', 'Lux-O-Matic',  
'Fyre-Freez' and the Kidde seal are  
trademarks of Walter Kidde & Company, Inc.





model **ET** Bagpaker®  
tapes and sews  
**15** bags per minute

**TAKE ADVANTAGE OF THESE 5  
MODEL ET BAGPAKER FEATURES:**

- One operator finishes 15 bags a minute when filled bags are delivered continuously to the conveyor
- Adjusts to bags from 25 to 100 lb. capacity
- Caster-mounted, the Model ET is easily moved to widely separated packaging stations
- Bag starts and stops sewing head when equipped with automatic sewing head control
- Automatic brake on Howpner No. 150 Heavy Duty sewing unit prevents "coasting"

Here's the perfect teammate for your present filling and weighing equipment—the most efficient way to get better protection and faster packaging at the lowest possible cost.

Here's how the Model ET Bagpaker works: One operator receives bags from your weighing and filling machine. In four seconds or less the Bagpaker has applied creped "kraft" sealing tape over the bag end, sewn a reinforced "cushion stitch" through both tape and bag, and trimmed the tape. You can't beat that for efficiency and speed.

Booklet ET gives you complete details and dimensional drawings, shows you how perfectly Model ET fits into your existing filling set-up. There's no obligation—just write to: E-16

International Paper Company, Bagpak Division  
220 E. 42 Street, New York 17

**International**  **Paper** COMPANY  
BAGPAK DIVISION

BRANCH OFFICES: Atlanta • Baltimore • Baxter Springs, Kansas • Boston • Chicago • Cincinnati • Cleveland • Dallas • Denver • Des Moines • Detroit • Kansas City, Kansas • Los Angeles • Louisville • Minneapolis • New Orleans • Philadelphia • Pittsburgh • St. Louis • San Francisco • IN CANADA: The Continental Paper Products, Ltd., Montreal, Ottawa, Toronto

**industrial  
propellers**

**for** { **MIXING**  
**PUMPING**  
**AERATING**  
**AGITATING**

Send for free Technical Bulletin IP

**Columbian**  
BRONZE CORP.  
Freeport, L. I., N. Y.

Standard for Half a Century

**NORIT**

**Highly Active Decolorizing Carbons**

Decolorization and Purification of organic and inorganic chemicals for industrial and pharmaceutical purposes. Special granular grades for adsorption of gases and vapors, solvent recovery, separation of gas mixtures and distillates, or to act as a catalyst-carrier.

AMERICAN NORIT COMPANY, INC., Jacksonville 8, Fla.

THE NORIT SALES COMPANY OF CANADA, 459, Church Street, Toronto, Ont.

UNITED NORIT SALES CORPORATION LTD., Amsterdam, Holland

## WHERE TO BUY

Featuring additional Equipment Materials, Supplies and Service for the Process Industries

**Crush DRY ICE**

Takes 50 lb. Cake. Gives Crushed Sizes: Powder,  $\frac{1}{2}$ ", 1", 2".

FRANKLIN P. MILLER & SON, Inc.  
36 Meadow St., East Orange 11, N. J.

**SUPREME CRUSHERS**

**TANK-METER**  
FOR MEASURING TANK CONTENTS ANY DISTANCE AWAY

**Uehling**  
INSTRUMENT CO.  
491 GETTY AVENUE, PATERSON, N. J.

**Make it a HABIT . . .  
to check this page  
—EACH ISSUE**

This WHERE TO BUY Section supplements other advertising in this issue with these additional announcements of products and services essential to efficient and economical operation in the process industries.

## 5 CORROSION CONTROL SERVICES

You'll Find Metalweld Services A Sound Investment, Not An Expense!

1. SYNTHETIC RESIN COATINGS — Application of Vinyl, Epon, Baked Phenolic, Neoprene, Thiokol Coatings in the MW Plant and in the field. RR siding for lining tank cars.
2. RUBBER LININGS — Rubber and Koroseal Sheet Linings applied to tanks, pipe, process equipment, etc.
3. METALLIZING — Sprayed Zinc and Aluminum for Corrosion Protection. Metal Spraying to build up parts, rolls, shafts, journals, etc.
4. MW PLASTICOTE LINING — Applied to hot water tank interiors — eliminates rust — passes inspection.
5. SURFACE CLEANING — Sand and Steel Grit Blasting in the large MW blastrooms or in the field.

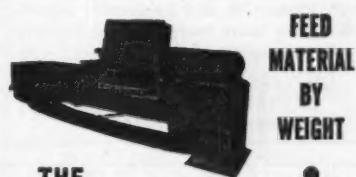
**CONSULT BEFORE YOU SPECIFY**  
Send Us Facts or Ask for Literature!

**PROTECTIVE COATINGS DIVISION**



**METALWELD, INC.**

Scotts Lane & Cresson Ave.  
Phila. 29, Pa. • Victor 8-1810



FEED  
MATERIAL  
BY  
WEIGHT

THE  
MERRICK FEEDOWEIGHT

MERRICK SCALE MFG. CO.  
171 SUMMER ST., PASSAIC, N. J.

**CHEMSTEEL CONSTRUCTION COMPANY, INC.**

501 Chemsteel Bldg., Walnut St., Pittsburgh 32, Pa.

Send data on Engineering & Construction facilities for  
**ACID-ALKALI-PROOF CONSTRUCTION**  
of processing & storage tanks & flooring.

NAME .....

COMPANY .....

ADDRESS .....

CITY ..... ZONE ..... STATE .....

CLASSIFIED

# SEARCHLIGHT SECTION

ADVERTISING

EMPLOYMENT • BUSINESS

## OPPORTUNITIES

EQUIPMENT—USED or RESALE

## UNDISPLAYED RATE:

\$1.50 a line, minimum 3 lines.  
To figure advance payment count 5 average words as a line.

POSITION WANTED undisplayed advertising rate is one-half of above rate, payable in advance.

PROPOSALS, \$1.50 a line an insertion.

Send NEW ADVERTISEMENTS to N. Y. Office, 330 W 42nd St., N. Y. 36, N. Y., for February issue closing January 3rd

## ACETYLENE RESEARCH

A growing West Coast chemical company in a suburban location requires a chemist or chemical engineer, preferably with an advanced degree and with experience in the high pressure techniques employed in the utilization of acetylene. This man will be responsible for formulation and prosecution of a program of research on acetylene chemicals. Candidates should possess an excellent technical background and the interest and ability to lead a group to carry forward work on commercially promising products.

Please submit complete resume (and recent photograph if available) for consideration in strictest confidence to

P-4652, Chemical Engineering  
68 Post St., San Francisco 4, Calif.

## IGNITRON ENGINEER

Berkeley, California

To assume part responsibility for magnet power supply for new Bevatron, world's largest particle accelerator.

Must be B.S. or M.S. in E.E., U.S. citizen with interest in and preferably experience with large pumped-down Ignitron rectifier-inverters. Salary open.

UNIVERSITY OF CALIFORNIA  
RADIATION LABORATORY  
Berkeley, California

## EXCLUSIVE TERRITORIES AVAILABLE

For firms or individuals to sell and service leading manufacturers complete line of

### Corrosion Proof Materials and Construction

On Commission Basis. Locations Available: Alabama, Carolinas, Georgia, Kentucky, Minnesota, Missouri, Virginia, Washington State.

RW-4227, Chemical Engineering  
520 N. Michigan Ave. Chicago 11, Ill.

## CHEMICAL ENGINEERS

An active, confidential service!  
Interview at your convenience.  
Call, write or wire

GLADYS HUNTING (Consultant)  
DRAKE PERSONNEL, INC.  
7 W. Madison St. Chicago 2, Ill.

## INFORMATION

BOX NUMBERS count as one line additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

## DISPLAYED RATE:

The advertising rate is \$14.75 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request. AN ADVERTISING INCH is measured  $\frac{3}{16}$  inch vertically on one column, 3 columns—30 inches—to a page.

C. E.

REPLIES (Box No.): Address to office nearest you  
NEW YORK: 330 W. 42nd St. (36)  
CHICAGO: 520 N. Michigan Ave. (11)  
SAN FRANCISCO: 68 Post St. (4)

## POSITIONS VACANT

SALES ENGINEER for large eastern steel plate fabricator. Must be thoroughly versed in all phases of Process Equipment such as Towers, Condensers, Autoclaves, Pipe fabrication etc. both in steel and the alloys. Will operate out of metropolitan New York office and be willing to travel. Must have well established reputation and reasonable following in the field. Salary open. P-4694, Chemical Engineering.

DEVELOPMENT ENGINEER, 26-33, graduate engineer with mechanical training and/or several years general experience, for work in general design, fabrication and/or requisition, operation, and maintenance of laboratory and pilot plant equipment connected with development of new or improved processes and products involving the use of wood fiber as a basic raw material. Salary—open. Location—North Central. P-4869, Chemical Engineering.

GRADUATE CHEMICAL Engineer, under 30 years of age having minimum of 15 years industrial chemical experience. Position entails general plant management; wide range of chemical engineering including operations and maintenance of sugar processing equipment and chemical controls. Large American-owned sugar company operating in Cuba. Good quarters furnished by Company. Salary not subject to U. S. income taxes under present laws. Reply giving complete details, stating age, marital and military status, experience, technical training and salary requirements. Reply will be held confidential. Address Box P-4857, Chemical Engineering, 330 West 42nd Street, New York 18, N. Y.

## EMPLOYMENT SERVICES

SALARIED POSITIONS \$5,000 to \$35,000. We offer the original personal employment service (established 45 years). Procedure of highest ethical standards is individualized to your personal requirements. Identity covered, present position protected. Ask for particulars, R. W. Bixby, Inc., 653 Brisbane Bldg., Buffalo 3, N. Y.

SALARIED PERSONNEL, \$3,000-\$25,000. This confidential service, established 1927, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. P, 241 Orange St., New Haven, Conn.

## POSITION WANTED

CHEMICAL ENGINEER—4 years Design and Construction,  $3\frac{1}{2}$  years Pilot Plant, Northeast preferred. PW-4844, Chemical Engineering.

CHEMICAL ENGINEER—Five years processing large refinery, ten years resident engineer rapid growth refinery, petro-chemical processing. Good health. Long-range opportunity desired. PW-4888, Chemical Engineering.

## SELLING OPPORTUNITY WANTED

SALES ENGINEERING Organization with wide experience & contacts, wishes to represent manufacturer of Heat Exchangers & Alkaline Chemical Process Equipment on an exclusive basis in the Met. New York North, N. J. and S. W. Conn. territory. RA-4272, Chemical Engineering.

## CHEMICAL ENGINEER

Chemical Engineer experienced in resistance films and resistor materials needed for printed circuit research and development program in the Research Department of an Ohio manufacturer of electronic equipment.

Man accepted will be responsible for this phase of work and will report directly to the department head.

Salary open. Replies held in confidence. Allowance for moving expense.

Submit resume to

P-4811, Chemical Engineering  
330 W. 42 St., New York 36, N. Y.

## OPPORTUNITY PIGMENTS DISPERSION

Man who has working knowledge in the techniques of pigment dispersion on all types of mills—with an interest in industrial engineering for position with progressive paint concern, to direct new program for improving output rates of all types of paint mills.

Write: Box CE-1976, 221 W. 41 St, NYC

## ENGINEERS

Large Chemical Plant New Orleans area, Opening for Chemical Engineers in Intermediate and Sr. classifications. Also Intermediate Mechanical Engineer. Four to ten years experience required in design and chemical plant engineering. Oil refinery or construction experience will be considered.

P-4638, Chemical Engineering  
520 N. Michigan Ave., Chicago 11, Ill.

### CUSTOM REFINING FACILITIES . . .

- Complete Distillation Service • Distillations
- Extractions • Fractionations Drum Lots-Tank Carts
- All Types of Crude Mixtures
- By-Products, Residues, Wastes
- Contaminated Solvents

**Truland** CHEMICAL &  
ENGINEERING CO., Inc.

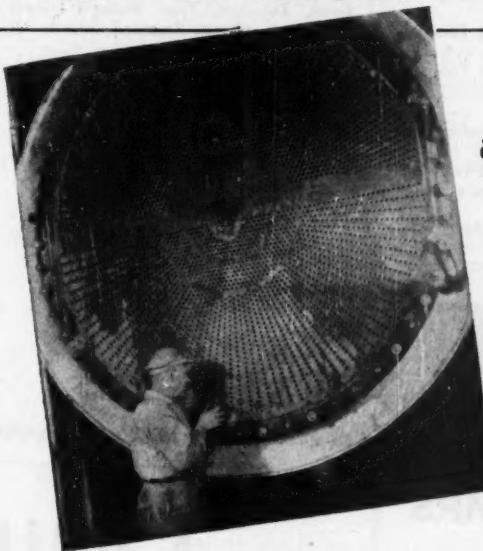
Box 426, Union, N. J.

Murdock 6-5252

# SAVE BOTH WAYS . . .

**1—ON THE SERVICE YOU NEED  
2—ON THE EQUIPMENT YOU WANT**

## FAST RETUBING and REPAIRS ON ALL TUBULAR EQUIPMENT



**Call the Largest  
and best equipped  
repair service  
in the country**

For condensers—or any other equipment with tubes—you want experience and dependability in a service organization. That's where we shine. We have the special tools that get hard jobs done fast. For instance, on the condenser shown above, 3520 cupronickel tubes were supplied by us out of our vast tube stock and were installed by us in about 68 hours!

Our expert crews go anywhere, any day, any hour. So, next time you're in trouble and want us fast, at low cost, write, wire or phone MAINTENANCE DIVISION.

### MORE ECONOMIES

- 1—Read Standard horiz. dbl. ribbon Mixer, center disch. 8' x 36" x 42", 2,000#, 480 gal., practically new.
- 1—Day #30 Imperial dbl. sigma blade, jack. Mixer, 75 gal.
- 3—Colton 5½ single punch Tablet Machines, M.D.
- 3—3' x 50' Rotary D. H. Dryers or Coolers.
- 2—Link-Belt Co. S/S 5'2" x 16', No. 502-16 Roto Louvre Dryer.
- 2—CME Cont. S/S Centrifugal, Solid bowl, 21" & 30" x 40".

**MEMO.....** Sell your idle machine—or entire plant quickly and confidentially. Send list today.

SPACE PREVENTS COMPLETE LISTING—WIRE • PHONE • WRITE



**CONSOLIDATED**  
PRODUCTS CO. INC.  
ON OBSERVER HIGHWAY, HOBOKEN, N. J. Tel.: HOboken 3-4425

Our 38th Year

DAY, NIGHT AND  
HOLIDAY SERVICE  
N.Y.TEL.BArclay 7-0600

Cable Address  
Equipment Hoboken, N. J.

### 24-HOUR DAY, NIGHT AND HOLIDAY SERVICE

"Consolidated gives you the facilities of the country's largest rebuilding Shop for ASME-U69 code work. We recondition thoroughly and promptly HEAVY PROCESSING EQUIPMENT. We also repair and build Pressure Vessels, Jacketed Kettles, Vulcanizers meeting code requirements.

### TUBULAR EQUIPMENT

We have on hand one of the largest stocks of tube sheets, cupro nickel, admiralty and aluminum tubes, plain and finned, enabling us to give you immediate service. Repairs may be done in our shops or our crews will visit your plant for retubing and repair of Heat Exchangers, Condensers and other types of tubular equipment.

### METAL SPRAYING

We are fully equipped to do metal spraying in a broad variety of metals at our plant or on your premises.

Our 38 years of experience in rebuilding and furnishing a broad line of EQUIPMENT to the PROCESS INDUSTRIES is your best assurance of satisfaction. No matter how urgent your requirements, we are ready to serve you.

Phone, wire or write  
**MAINTENANCE  
DIVISION**

### NEW EQUIPMENT

We also manufacture  
CONDENSERS  
HEAT EXCHANGERS  
PRESSURE VESSELS  
ROTARY KILNS, DRYERS AND  
COOLERS  
ROTARY MIXERS AND  
BLENDERS

Ask us to quote on your requirements

# MODERN REBUILT EQUIPMENT UNION

## Specially Priced For Quick Sale

**MIXERS**

650 to 850 gal. Jacketed Mixing Tanks.  
Day 35 to 75 gal. S. J. Imperial D. A. Mixers.  
Day 650 gal. Jumbo Steam Jacketed Mixer.  
Koven 2000 gal. Spiral Jacketed Mixer.  
Stokes, Day, New Era, Hattman Mixers, from 2 to 450 gal., with and without Jackets, Single, Double Arm Agitators.  
Baker Perkins, Day, Readco Heavy Duty,  $\frac{1}{2}$  to 160 gals., Double Arm Jacketed Mixers with Sigma or Fish Tail Blades.  
Gemco 56 cu. ft. (66") Double Cone Blender.  
Day, Robinson, 15 to 10,000 lbs., Dry Powder Mixers.

**OVER 5,000 MACHINES IN STOCK—INSPECTION INVITED***Complete Details and Quotations Available on Request*

**UNION STANDARD EQUIPMENT CO.**  
318-322 Lafayette Street New York 12, N. Y.

**LABELERS**

Resina LC, Capem, Elgin Cappers.  
Burt, Kyler Wraparound Labelers, to gal.  
Pony M, MX, ML, World, Ermold, Pneumatic Semi Automatic and Automatic Labelers.

**FILLERS**

Pfaudler King C9 S. S. Rotary Filler.  
S. & S. GI and HG88 Duplex Auger Fillers.  
Carter Vacuum Powder Filler.  
Triangle Elec-Tri-Pak G2C, A3A Fillers.  
Filler 1, 4-Head, Elgin 5-Head and Hope 6-Head Stainless Steel Piston Fillers.

**PACKAGING**

Standard Knapp 429 Carton Sealers.  
Pneumatic Scale Cartoning Line.  
Miller, Hayssen, Package Machinery, H-S Campbell, Transwrap Wrappers.

**TABLET MACHINES**

Colton 2, 3 RP Rotary Tablet Machines.  
Colton #5½ Single Punch Tablet Machine.  
Stokes RB and RD Rotary Tablet Machines.

**GRINDING MILLS**

Mikro 4TH, 3W, 1SH and Bantam Pulverizers: Schultz O'Neill Mills.  
Eppenbach V9 Aloxite Grinding Mill.  
Rotex, Robinson, Tyler Hummer, Great Western, Gayco, Raymond Sifters, all sizes.

**MISCELLANEOUS**

Oliver, Sweetland #2, Sparkler, Sperry, Shriner, Alsop Filters.

Immediate Deliveries

## TANKS — BOILERS — PUMPS

NEW and USED  
**SPECIAL**

| Quantity | Diam.   | Length | Shell | Heads | Capacity    | Price        |
|----------|---------|--------|-------|-------|-------------|--------------|
| 2—Tanks  | 8"      | 32"    | 5/16" | 2½"   | 11,100 gal. | \$1,100 each |
| 2—Tanks  | 9 1/2"  | 30"    | 5/16" | 2½"   | 15,500 gal. | 1,800 each   |
| 5—Tanks  | 10 1/2" | 28"    | 5/16" | 2½"   | 16,948 gal. | 1,650 each   |

F.O.B. ROCHESTER, N. Y.

4—Vert. Tanks, 28" dia. 19 1/2" high, 180,000 gal., each, welded, heavy plate.

1—New Louisville DeWaterring Press, 8-roll, 3' wide.

1—New Louisville Conveyor, 3'x18'.

Large Stock of Chemical Plant Equipment  
MIXERS — FILTERS — CONDENSERS — BALL MILLS — PULVERIZERS — HEAT EXCHANGERS  
DRYERS — AMMONIA — FREON COMPRESSORS — EXTRACTORS — HAMMER MILLS —  
STEAM JACKETED KETTLES — STAINLESS STEEL TANKS — CONVEYOR MOTORS —  
CRYSTALLIZERS — POWDER FILLERS — TABLET MACHINES — S. S. VALVES

H. LOEB & SON :: 4643 LANCASTER AVENUE PHILADELPHIA 31, PA.

FEEDER—SYNTRON Vibra flow—Type F44-440V w/controls—also Apron 40" W x 48" C/C-3 H. P. vari.  
SCREENS—Tyler Hummer 3 x 5 single/triple-Robbins 4 x 12 triple.  
MILLS—Hardinge 24" lab unit—auto feed/cyc.—6' x 22"—7' x 22"—7' x 48" pebble COMPRESSOR—194 CFM—100 PSI—Gardner Denver w/40 H. P. 3/60/220/440 Motor  
MIXERS—Simpson 24" & 11½" Lancaster EAG 4 (15 H. P. vari) Robinson cont.—New 600# Ribbon blenders—W & P 80 gal 2 sigma ROTARY DRYERS/KILNS—3'—25" 5½" x 40"—6' x 80"—11' x 75"—8' x 125".  
CRUSHERS—JAW—9 x 15—11 x 26—24 x 36 HAMMER MILLS—Wms 8 x 14—24 x 30 (GA30) for 150 H. P. drive  
FORK LIFT TRUCKS—7500# cap-pneumatics—new engine-Hyster  
NASH HYTOR VACUUM PUMPS & COMP'S—MD673 (3 H. P.) MD623 (20 H. P.) bronze ORE BENEFICIATION PLANT—15 TPH (mang.) PEBBLE MILLS—24 x 36—60 x 48—porcelain linings—motor drive  
OIL BURNER—Hauck w/Spencer 1300 CFM 16 oz. blower  
GEAR REDUCERS & NEW WEST. 7½ H. P. gear motors C1 1 Gr. D 350 RPM output

**LAWLER COMPANY**Durham Avenue Metuchen, N. J.  
Metuchen 6-0245**PRICES SLASHED!!!**

All EQUIPMENT in our stock can be purchased at 25% to 50% of the new cost. Come in and see for yourself.

**MIXERS OF ALL KINDS—SS****COLLOID MILLS****FILTERS & FILTERPRESSES****REACTORS****PUMPS—PULVERIZERS—DRYERS, ETC.**

NEW MACHINERY DIVISION  
STEEL & S/S MIXERS, TANKS,  
KETTLES & ROTARY DRYERS  
Fabricated To Your Specifications  
Engineering Advice Available

We Buy Complete Plants Or Single Units  
YOU CAN BANK ON

**EQUIPMENT CLEARING HOUSE, INC.**  
111 33rd STREET, BROOKLYN, N. Y.  
SOuth 8-4451—9264—8782

**EQUIPMENT**  
Latest type Metallurgical and Chemical Equipment  
EXCELLENT CONDITION

Hardinge Conical Ball Mill 10' x 48"

Oliver All Iron Rotary Vacuum filters

Bufflovak Twin Drum Dryer

Dorr Type A Thickeners

Allis-Chalmers type 222 Gyrotary Crusher

Link Belt Screw &amp; Belt Conveyors

Norblo &amp; Sly Dust Collectors

Dorr, Morris, Worthington process pumps

Research Corp. Electrostatic Precipitator

The above items include all auxiliary equipment with individual motor and control 230/440/5/60. The equipment may be inspected on foundations.

Complete List  
with Specifications  
Available

**VULCAN DETINNING CO.**  
SEWAREN, N. J.

**FOR SALE**

1—Sharples No. C. 20, Stainless steel. Type 318. Super Dehydrator, with standard cycle controls, 20 HP, 220 volt, 3 phase, TEFC motor. Used only one month. Price \$12,500.00. FOB shipping point.

FS-4688, Chemical Engineering  
530 N. Michigan Ave., Chicago 11, Ill.

# IT WILL PAY YOU TO INVESTIGATE OUR LARGE STOCK

## LIQUIDATING

### LITHOPHONE MFG. PLANT

*located in Delaware*

- 1—4700 gal. Nickel Clad Tank
- 1—2000 gal. St. Clad Tank
- 1—Traylor Rotary Kiln 10'6" dia. x 112' long, welded.
- 1—Allis Chalmers 6' dia. x 16' long steel lined continuous Ball Mill
- 3—Patterson & Abbe 4'6" dia. x 12' cont. Pebble Mills
- 2—Charlotte Colloid Mills, model #50, 75 HP motor
- 1—Humboldt Colloid Mill, 50 HP
- 1—Bird solid bowl Centrifuge 36" x 50".
- 4—Muffle Furnaces 24" dia. x 8'6" long rotary chrome nickel alloy tubes
- 3—Trough Belt Conveyors, 22' to 35' long
- 5—Pan Conveyors, 12' to 95' long
- 1—Jeffrey Pivoted Bucket Carrier, 185 ft., 16" x 18" piv. bkts.
- 1—Sperry 30" C.I. Filter Press, 46 ch., cl. dly.
- 2—Sperry 42" Skeletons  
Miscel. Items—Tanks, Crushers, Bins, Blowers, Pumps, etc.

## ANOTHER SALE DISTILLERY EQUIPMENT

*Louisville, Ky.*

- 2—Rotex Screens, single deck, 40 x 96; 48 x 96
- 2—4'6" x 40' Louisville Rot. Steam Tube Dryers.
- 2—42" x 120" Double Drum Dryers.
- 1—Raymond #120 Flash Dryer, 6' dia. fan
- 2—Bucket Elevators 91' H, 6 x 4.  
500' Screw Conveyor, 9" x 12" dia.
- 8—Centrifugal Pumps with 10 HP to 30 HP motors—250 GPM to 800 GPM
- 1—Nash Hytor Compressor with 20 HP motor
- 6—Vertical and Side Entering Agitators, 3 HP to 15 HP

Equipment  
Bought & Sold

Phone  
ST evenson 4-7210  
Cable—PERI



**PERRY**  
**EQUIPMENT CORP.**

1413 N. 6TH ST., PHILADELPHIA 22, PA.

- 1—500 gal. St. St. Evaporator, 145 sq. ft. heating coil
- 1—2600 gal. T347 St. St. Jktd. Vacuum Kettle
- 1—Fitzpatrick Model F. Comminuting Mach, 25 HP
- 1—Conkey Triple Effect Evaporator, Herculoy, total 1900 sq. ft.
- 2—Blaw Knox ½ gal. St. St. Autoclaves, 2000# pr., Agit.
- 15—Distillation, Solvent Recovery, and Absorption Columns — 8" to 72" dia. — Aluminum, Copper, Steel, Stainless Steel
- 1—Sharples 16P St. St. Centrifuge
- 1—A.T.&M. 48" Susp. Centrifugal, Perf., St. St. Fume Tight
- 5—1200 sq. ft. Steel Shell & Tube Heat Exchangers—Unused
- 1—Stokes 3' dia. x 15' L Jacketed Rotary Vacuum Dryer 400' T316 St. St. Pipe 2½"
- 1—8800 gal. Vacuum or Pressure Cooker with agitator and vacuum pump, ASME 85#
- 6—Atm. Double Drum Dryers, 22" x 38", 24" x 60", 42" x 120"
- 6—Shriver 30" x 30" C.I. Filter Presses, open del 17 to 50 ch.
- 1—Sperry 15" aluminum P & F Filter, 29 ch.
- 2—W & P 100 gal. Sigma Blade Jktd. Mixer
- 1—Day 10 gal. St. St. Sigma Blade Jktd. Mixer
- 2—Pebble Mills 6' D x 8' L.
- 20—Aluminum Tanks — 500 to 4000 gal.
- 12—Copper Tanks, 1763 to 5500 gal.
- 30—Welded Steel Tanks — 3800 to 23,000 gal.
- 30—Agitator Drives 3 to 40 HP

## HQ. FOR STAINLESS STEEL EQUIPMENT

### USED EQUIPMENT IN STOCK

- 50—S.S. Storage Tanks from 15 gal. to 8000 gal. sizes.
- 15—S.S. Pressure or Vacuum Tanks from 9 gal. to 1100 gal. sizes.
- 20—S.S. Shell & Tube and coil type Condensers and Heat Exchangers from 14 to 785 sq. ft.
- 50—S.S. Jktd. open top Kettles from 35 gal. to 500 gal.
- 4—S.S. Jktd. agit. closed Reaction Kettles, 100, 450, 500 gal.
- 10—S.S. Side Ent. Agitators 7½ HP to 25 HP.

**CONVERTING OR CHANGING EXISTING EQUIPMENT—**  
(Your own equipment or our stock)—Can be done in our own shops utilizing good used or surplus new materials.

**FABRICATION—(IN OUR OWN SHOP)**—Heliarc welding. Water-quenched stabilized welds. Large stock of type 304 and type 316 sheets and prefabricated tank sections and heads carried in stock assuring quick delivery of tanks.

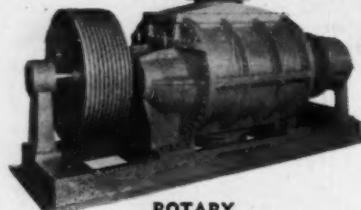
Chicago Branch  
617 Davis Street  
Evanston, Ill.

Phone  
Davis 8-0926

# FANS . . . BLOWERS . . . EXHAUSTERS

NEW AND REBUILT

## 30% to 50% Savings — Stock Shipment


**ROTARY  
POSITIVE BLOWERS**

| MAKE        | SIZE    | TYPE | Max.<br>Press. | Max.<br>Cfm |
|-------------|---------|------|----------------|-------------|
| Roots-Conn. | 8 x 20  | RCR  | 7.5            | 955         |
| Surfbilt.   | 18 x 42 | XB   | 4              | 5320        |
| Roots-Conn. | 22 x 36 | RCD  | 5              | 5500        |
| Roots-Conn. | 67      | AF   | 5              | 164         |
| Roots-Conn. | 14 x 36 | RCR  | 5              | 3580        |
| Roots-Conn. | 16 x 24 | RCD  | 5              | 2515        |
| Roots-Conn. | 10 x 18 | RCD  | 6              | 805         |
| Roots-Conn. | 10 x 12 | RCS  | 7              | 614         |
| Roots-Conn. | 76      | AF   | 7              | 200         |
| Surfbilt.   | 5H      | Cal. | 10             | 66          |
| Surfbilt.   | 8H      | Cal. | 10             | 272         |
| Roots-Conn. | 10 x 10 | RCR  | 10             | 616         |
| Roots-Conn. | 24 x 23 | RCDH | 7.5            | 8610        |
| Roots-Conn. | 32 x 32 | RCDH | 7.5            | 14950       |

Stock List: RP-100

| MAKE          | SIZE  | TYPE | 3 Diam. | Inlet  | • |
|---------------|-------|------|---------|--------|---|
| American      | 11    | FH   | 62 1/4  | 73 3/4 |   |
| American      | 9     | AHS  | 53 1/4  | 61     |   |
| Clarage       | 3 1/4 | W    | 42 1/4  | 44     |   |
| Baird & Power | 8     | ME   | 40      | 41     |   |
| New York      | 26    | ME   | 36      | 39 1/4 | • |
| Sturtevant    | 8     | DW   | 27      | 27 1/2 |   |

Stock List: BC054



| MAKE          | SIZE  | TYPE | 3 Diam. | Inlet  | • |
|---------------|-------|------|---------|--------|---|
| American      | 11    | FH   | 62 1/4  | 73 3/4 |   |
| American      | 9     | AHS  | 53 1/4  | 61     |   |
| Clarage       | 3 1/4 | W    | 42 1/4  | 44     |   |
| Baird & Power | 8     | ME   | 40      | 41     |   |
| New York      | 26    | ME   | 36      | 39 1/4 | • |
| Sturtevant    | 8     | DW   | 27      | 27 1/2 |   |

Stock List: BC054

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**TURBO BLOWERS**

| Stock | No. Make        | Size    | HP    | Vol.  | Press. -oz. |
|-------|-----------------|---------|-------|-------|-------------|
| 1601  | General Blower  | 1630    | 30    | 3600  | 16          |
| 1529  | Ingersoll Rand  | FS377   | 150   | 15000 | 20          |
| 2415  | Spencer         | 1515-H  | 15    | 1425  | 24          |
| 3525  | Spencer         | 2000    | 20    | 1300  | 32          |
| 683   | Allen Billmeyer | D-6     | 7 1/2 | 275   | 48          |
| 1000  | Spencer         | Special | 200   | 8200  | 48          |

Stock List: TB155

**FULLY  
GUARANTEED****STEEL PLATE EXHAUSTERS**

| MAKE          | SIZE | TYPE   | Wheel Diam. | Inlet Diam. |
|---------------|------|--------|-------------|-------------|
| Sturtevant    | 100  | Deg. 3 | 72 1/4      | 38          |
| Sturtevant    | 70   | Deg. 3 | 49 1/4      | 29 1/2      |
| American      | 80   | ELS    | 49 1/4      | 25 1/2      |
| American      | 55   | ELS    | 36 1/4      | 23          |
| Sturtevant    | 50   | Deg. 3 | 36          | 19          |
| New York      | 23   | GI     | 33          | 21 1/4      |
| Buffalo       | 45   | MW     | 32          | 19 1/2      |
| American      | 50   | ELS    | 31          | 18 1/4      |
| Go-Bill Power | 45   | MX     | 27          | 18 1/4      |
| American      | 30   | E      | 23          | 15          |
| Sturtevant    | 30   | Deg. 2 | 18          | 11          |
| American      | 3    | VRV    | 13          | 7           |
| American      | 3    | V      | 12          | 7           |

Stock List: MX115

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1—Stokes 2' x 8' Rotary Vac. Dryer  
Devine 3 1/2 Vac. Shelf Dryer 40" x 42" shelves.  
Gen. Amer. 2' x 1' Continuous Rotary Vac. Filter.  
2—Albright-Nell 4' x 9' Atmos. Drum Dryers.  
1—Deutsche Vac. Drum Dryer 24" x 20".

**CENTRIFUGALS & CENTRIFUGES**

4—Tolhurst 48" Suspended Type Centrifugals.  
6—Centrifugals 12", 30", 40" & 48" Steel, Copper, Stainless & Rubber Lined.  
6—Described Centrifugals #5A Stainless. Also #5.  
3—De Lava Multiple Clarifiers #200, 300 & 500.

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1—Vallier 41 Stainless Covered Leaf Filter, type 48.  
Sperry & Shriver 12" to 36" Iron & Steel.  
Sweetland & Oliver Rotary Vac. Filters.

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1—Deep 350 gal. C.I. Jack. Kettle.  
Devine & Stokes Impres. Units 30" & 36" dia.  
Devine 1000 gal. closed Jack. Steel Kettle.  
1—2300 gal. vert. agit. Jack. Steel Kettle.  
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1—50 gal. Lead-Lined Kettle.  
50—Stainless, Alum., Copper, Glass & Lead Lined Kettles & Tanks. Also new Stainless.  
1—250 gal. vert. Copper Jack. Kettle.

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Abbe 30" x 42" Pebble Mill. Also Jam Mill.  
1—Raymond Automatic Pulverizer 20 H.P. Complete.  
4—#8000 Raymond Mills.  
Sturtevant #8, 10" Hinged Hammer Mill.  
Jeffrey 18" x 18" Single Roll Crusher.  
Buchanan 5" x 12" Jaw Crusher.

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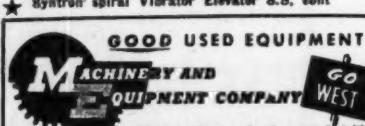
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- 1—Vulcan 4 $\frac{1}{2}$ 'x50' Rotary Dryer.
- 3—Link Belt, Hersey Rotory Dryers, S.S. 7'5"x20', 4"x30', 3"x20'.
- 4—Louisville Steam Tube Dryers 6'x50', 6"x35', 4"x40'.
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- 1—Stokes Vacuum Shelf Dryer #138-H-10 44"x40" shelves.
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- 1—Devine 5'x10' steel Rotating Vacuum Dryer.
- 1—Stokes 30"x8", 3'x15' Rotary Vac.
- 4—Buflovak Double Drum 32"x100", 36"x84", 32"x72", 32"x52".
- 1—Devine 2'x4' Vacuum Drum Dryer 316 S.S.
- 2—Buflovak 6" dia. Crystallizers.
- 1—Buflovak 6" dia. Vac. Crystallizer S.S.

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- 1—Sparkler #14-D-4, 316 S.S.
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- 4—Shriver 30" P&F 30 chambers.
- 8—Sperry 24" P&F 16 chambers.
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- 1—Sperry 36" P&F 4 eye, heresite coated.
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- 1—Bird 40" Suspended S.S.
- 1—Bird 40" Suspended, rubber covered.
- 2—Tolhurst 40" Suspended, steel.
- 1—AT&M 36" center slung, rubber covered.
- 1—Fletcher 30" Suspended, steel.
- 1—Tolhurst 28" Suspended, steel.
- 2—Tolhurst 30" center slung, steel.
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- 2—Sharples #16P Monel and S.S. Super Centrifuges.

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- 2—Raymond 3 and 5 Roll High Side Mills.
- 4—Hardinge Mills 4 $\frac{1}{2}$ 'x16", 5"x22", 5"x36". 6"x22", 10"x48".
- 4—Patterson 6"x8", 5"x8", 4"x5", 3"x4", brick-lined Pebble Mills.
- 1—Patterson 6"x8" porcelain (Beryllite) Pebble Mill, 50 HP, NEW.
- 1—Patterson 4"x4" porcelain lined, jacketed Pebble Mill.
- 1—Abbe "Eureka" #3 porcelain Jar Mill 14.7 gallons.
- 1—National 10"x20" two-roll Mill, 25 HP motor.
- 2—Premier Colloid Mills 8" dia., S.S.
- 1—Jeffrey 30"x24" Hammer Mill, Type A.
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EXCHANGERS

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- 3—High Pressure Furnaces Natural gas fired, 2 $\frac{1}{2}$  to 15 million BTU per hr.

Partial List Full Details on Request.

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- 1—#42 Rotex double deck 40"x84".
- 1—#11 Rotex single deck 20"x48".
- 1—#23 Rotex three deck 20"x80".
- 4—Tyler Hammer 4"x15', 4"x10', 4"x5' single deck with V-16 Vibrators.

## MIXERS

- 2—Banbury #9, #3A.
- 1—Baker Perkins 100 gal. S.S. jacketed, Vacuum Mixer, 75 HP.
- 1—Baker Perkins 50 gallon, Sigma Blades, jacketed.
- 6—Sprout Waldron S.S. jacketed Powder Mixers 67, 27 and 10 cu. ft.
- 1—Struthers Wells 6"x8" S.S. jacketed, Rotary Mixer.
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- 1—Robinson 4000# steel powder.
- 6—Rodgers 400 3000# powder.
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- 2—Blow Knox 800 gal. S.S. agitated Reactors 1000# int. press.
- 1—Struthers Wells 750 gallon, S.S. jacketed, agitated Reactor.
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- ★ Shriver & Sperry Stainless Filter Presses; 12" and 18".
- ★ 2 Lab. Size S.S. Sweetland Filter.
- ★ 2 Enzinger Pressure Filters; 15 leaves in tank 48" x 91".
- ★ A.T.&M. 30" S.S. Suspended Centrifuge, plow discharge; 20 HP.
- ★ A.T.&M. 42" Type 316 Stainless Suspended Centrifugal; 30/15 HP.
- ★ Sharples Super-D-Hydrators; Models C20 and C27 in Stainless.
- ★ Sharples Super-D-Canter Type 316 SS; Model PN 14.
- ★ DeLeval Nozzle Ejector Stainless Centrifuge or Yeast Separator.
- ★ Bird 36" x 50" Centrifugal Filter; Rubber Cov. & S.S.; 40 HP.
- ★ Bird 18" x 28" Continuous Steel Centrifuge with solid conical bowl.
- ★ Bird 40" x 60" Continuous Stainless Steel Centrifuge 50 H.P. plus accessories.
- ★ Horizontal Vulcanizer 6' x 10'; Simplex Door; ASME-U69; at 125# PSI.
- ★ Buflovak Stainless Clad Vac. Filter-Dryer; Jkt'd; 78" x 58" complete.
- ★ Stokes Rotary Jacketed Vacuum Dryer; 30" x 10' complete.
- ★ Devine Vacuum Shelf Dryer No. 12; shelves 40" x 42".
- ★ Squier Stainless Clad Rotary Atmospheric Dryer; 30" x 20'.
- ★ Hersey S.S. Rotary Gas Fired Dryer; 5' x 26'.
- ★ Bagley & Sewell Double Drum Dryer; 28" x 60" with Accessories.
- ★ C.E. Two Stage S.S. Flash Drying System; 1000 lbs. evap. per hour.
- ★ Raymond Flash Drying System including No. 47 Imp Mill, Dust Collector, Cyclone, Gas Fired Heater and accessories.
- ★ Louisville Steam Tube Dryer; 54" x 40' with Cooler 38" x 20'.
- ★ Rotary Jacketed Vacuum Dryer; 52" x 102"; Dust Collector and access.
- ★ American Double Drum Dryer; 36" x 84" with hood, screw conveyor, bucket elevator and flaker.
- ★ Mojonnier Stainless Vacuum Pan; 3' x 10' with Calandria Section.
- ★ Copper 2000 gal. Vacuum Pan; manhole type; coil heated.
- ★ Zaremba INCONEL Double Effect Evaporator; 60" x 17' and 84" x 15'6".
- ★ Swenson Quadruple Effect Evaporator; Long Tube Vert. Film Type.
- ★ Stainless Steel Bubble Cap Column; 16 sec.; 8½" x 19'; complete.
- ★ Aluminum Column; Bubble Cap; 60 plates; 27½" dia. x 36" high.
- ★ Pfaudler Glass Lined Jacketed Reactors; 150 gal. 400 gal., 1000 gal.
- ★ Monel 750 gal. Reactor; Jacketed and Agitated; 5' x 5'.
- ★ Lancaster Stainless Lined Rotary Reactor; 300 PSI; Int. 50" x 17".
- ★ Dopp Cast Iron Jacketed and Agitated Kettles; 650 gal.; 61" x 68".
- ★ Bethlehem Cast Iron Sulphonator; 79" x 74½"; with Coils in Jacket.
- ★ Orville Simpson Rotex Sifters; 30" x 60"; 60" x 84"; 40" x 120".
- ★ Robinson Unique Gyro Sifters; 20" x 69"; 20" x 86"; 40" x 60".
- ★ Allis Chalmers Roll Crusher stand of 4 Flaking Rolls 32" x 40" with 40 H.P. Motor and accessories.
- ★ Horizontal Lithcote lined Tank; 3500 gal. 6' x 17".
- ★ Stainless Steel 40 cu. ft. Double Ribbon Jacketed Mixer; 32" x 96".
- ★ Porter Type 316 S.S. 30 cu. ft. Ribbon Mixer.
- ★ Stainless Steel 63 cu. ft. Ribbon Mixer; 36" x 100".
- ★ Sprout Waldron 283 cu. ft. Steel Ribbon Mixer; 5' x 10'.
- ★ Readco 210 gal. Jacketed Heavy Duty Double Ribbon Mixer, 30" x 68".
- ★ Sprout Waldron Stainless Ribbon Mixer; Continuous Cylinder; 28" x 12'.
- ★ W. & P. Type Heavy Duty Double Arm Jkt'd. Mixer; 100 gal. working.
- ★ Baker Perkins 200 gal. Jacketed Double Arm Mixer; size 17; BB/V11.
- ★ Stainless Tumbling Barrel Mixer 5' x 5'; baffled interior; 3 H.P.
- ★ Lancaster Mix Mullers; Type EAG3 and EAG4 with accessories.
- ★ Colton Model #5½ Single Punch Tablet Press; 3" x 1½" die; 5 HP.
- ★ Ross Stainless Steel Heat Exchanger; 1100 sq. ft. surface area with 284 tubes; 13'3" long.
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- 1—Tolhurst 18" suspended, st. steel.

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- 1—3' x 24' Hardinge direct heat.

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- 2—Sprout Waldron, 27 cu. ft., jktd., SS Clad MIXERS.
- 1—Sprout Waldron, 10 cu. ft., jktd., SS Clad MIXER.
- 1—Unused Struthers Wells, SS Clad, jktd. REACTOR, 750 gal. 5'x4'6", dished top & bottom, SS agitator.
- 1—16"x12'6" Jacketed Rotary DRYER.
- 1—16"x12'6" American, gas fired KILN.
- 1—Patterson type 4'x4', porcelain lined, jktd. PEBBLE MILL.
- 1—Ball & Jewell, #1 Rotary CUTTER.
- 1—Stokes 243D, Oscillating GRANULATOR, steel.
- 4—Porter, SS, AGITATORS, side entering, 2 HP, V-Belt.
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- 1—Struther Wells, 24" x 30' Nickle Fractionating Tower 60 psi.



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### TANKS

- 1—Plaudler Glass lined, Series R, 500 gal. Jacketed Vacuum Reactor, with Impeller Type Agitator and Drive.
- 3—Open Top Type 316 Stainless Steel Jacketed Kettle, 700 gallons each.
- 2—Open Top Stainless Steel Jacketed Kettles, 600 gal. ea.
- 1—1600 gal. Type 347 Stainless Steel Storage Tank.
- 1—Vertical Storage Tank, 10,000 gal. capacity, 125 psi.
- 1—Walter, Stainless Steel Agitated Jacketed Reactor 60 gal.
- 3—Stainless Steel Jacketed, Agitated Vacuum Kettles 650 gal.
- 1—Struthers Wells Steel Jacketed Vacuum Reactor, 1800 Gals. Cap. with Drive, Turbine Agitator & Coils.
- 12—Koven Stainless Steel Jacketed Vacuum Kettles, 380 Gals. Cap. Each.

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- 1—DeLaval Type 316 Stainless Steel Multi-Matic Centrifuge.
- 1—Fletcher Stainless Steel Suspended Type Centrifuge, 40" Perforated Basket.
- 1—A. T. & M. Stainless Steel Susp. Centrifuges, 48" Imperforated Basket.
- 1—Sharples Type 316 S.S. Super-D-Hydrator, Model No. C-20.

### DRYERS—KILNS

- 1—Buflovak Type 347 Stainless Steel Rotary Vacuum Dryer, 5' x 20'.

- 3—Devine Single Door Vacuum Shelf Dryers, 5-13 shelves.
- 1—Stokes Rotary Vacuum Dryer, 3' x 12'.
- 1—Vulcan Rotary Kiln, 7' x 120'.
- 1—Louisville Experimental Laboratory Dryer, 12" x 7½'.
- 1—Devine #A Laboratory Vacuum Shelf Dryer with 3 Stainless Steel shelves.

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- 10—Shriver & Sperry Plate and Frame Filter Presses from 12" to 42".
- 1—Sweetland #2 Stainless Steel Filter.
- 2—Feinc Type 316 Stainless Steel 6'6" x 6' Rotary Vacuum String Discharge Filters, Complete. New.
- 1—Shriver, 36" x 36" cast iron 4-eye closed delivery Filter Press with Hydraulic closing device, 64 chambers.
- 1—Shriver, 30" x 30" cast iron 4-eye closed delivery Filter Press with 34 chambers.

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- 6—Simpson Intensive Mixers #0 and #1.
- 4—Baker-Perkins Double Arm Jacketed Sigma Blade Mixers, 100 gal. capacity.
- 1—Baker Perkins Stainless Steel Dispersion Mixer, Size 15, Type VUMM, 100 Gals.
- 1—Struthers Wells Double Arm "Northmaster" Mixer, 50 Gals. Working Cap., 100 Gals. Total Cap.
- 1—Lancaster, Stainless Steel Muller Mixer Model LW w/motor.
- 1—Baker Perkins, Double Arm Naben Blade Mixer, 100 gal. capacity with hydraulic tilting device.

- 1—Badger 4' x 16' Copper Column 25 bubble cap trays.
- 1—Day 50 gal. Stainless Steel, jacketed double sigma blade mixer.
- 3—Buflovak Single Door Vacuum Shelf Dryers, 20 shelves each.
- 1—Badger, 5' dia. x 23' Copper Column 20 bubble cap trays (New).
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- 1—Mikro #2TH Stainless Steel Pulverizer.
- 1—Mikro #3TH Mikro Pulverizer with 30 HP Motor.
- 1—Mikro #3W Pulverizer.

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- 1—IPE Type 316 Stainless Steel 50 sq. ft. Evaporator.
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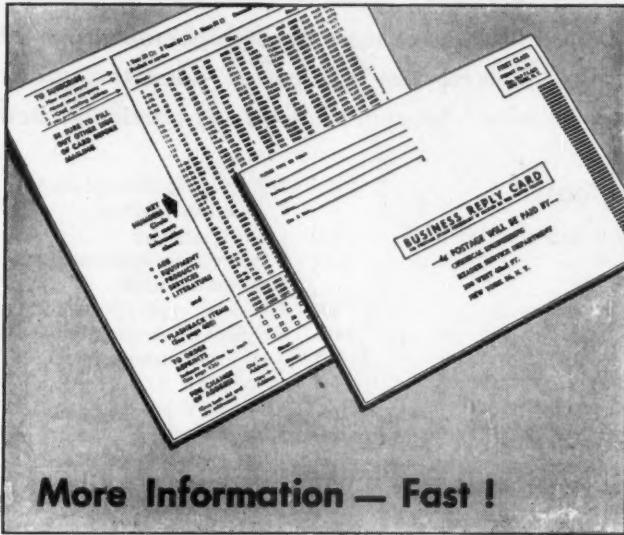
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#### INDEX TO CHEMICALS & EQUIPMENT

|   |            |
|---|------------|
| <b>Chemicals and materials</b> .....              | <b>366</b> |
| <b>Equipment and accessories</b> .....            | <b>367</b> |
| <b>Processes and services</b> .....               | <b>374</b> |
| <b>Flashback: Last month's new products</b> ..... | <b>375</b> |

#### GUIDE TO TECHNICAL LITERATURE

|  |            |
|--|------------|
| <b>Chemicals and materials</b> .....     | <b>376</b> |
| <b>Construction materials</b> .....      | <b>380</b> |
| <b>Electrical equipment</b> .....        | <b>381</b> |
| <b>Handling and packaging</b> .....      | <b>382</b> |
| <b>Heating and cooling</b> .....         | <b>382</b> |
| <b>Instruments and controls</b> .....    | <b>383</b> |
| <b>Mechanical equipment</b> .....        | <b>381</b> |
| <b>Pipe, fittings, valves</b> .....      | <b>388</b> |
| <b>Process equipment</b> .....           | <b>389</b> |
| <b>Pumps, blowers, compressors</b> ..... | <b>394</b> |
| <b>Services and Processes</b> .....      | <b>395</b> |

#### INDEX TO ADVERTISERS

|   |            |
|---|------------|
| <b>Alphabetical list of firms in this issue</b> ..... | <b>396</b> |
|---|------------|

#### CHECK LIST OF REPRINTS

|  |            |
|--|------------|
| <b>Editorial reports now available</b> ..... | <b>404</b> |
|--|------------|

#### READER SERVICE POSTCARDS

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|--|---------------------|
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Each item has a code that's the key to its location in this issue. The numerals show the page where you'll find the item mentioned. The letters L (left), R (right), T (top), B (bottom) locate ad positions on the page; the letters a, b, c and A, B, C identify items on a page or in an ad.

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### Contents of This Section . . .

You'll find the product items in this issue's directory and categorized as follows:

|  | Page |
|--|------|
| Chemicals and materials                | 366  |
| Equipment and accessories              | 367  |
| Processes and services                 | 374  |
| Checklist of last month's new products | 375  |

## Index to Chemicals & Equipment

Find it tough to keep up with chemical products and equipment? You can use this master index as a quick way to spot exactly what's in each issue on any particular item.

### Chemicals

|                                     |              |                                  |              |
|-------------------------------------|--------------|----------------------------------|--------------|
| Acetic anhydride                    | 376A         | Diatomaceous silica products     | 137          |
| Achromycin                          | 134-5a       | 1, 2-Dichloroethylene            | 377A         |
| Acid                                |              | Diethyl malonate                 | 377B         |
| Benzene phosphoric                  | 376B         | 3-Diethylaminopropylamine        | 134-5f       |
| Fatty, tech, inf.                   | 44-A, 44E    | Diethylene triamine              | 377C         |
| Hydrofluoric                        | 105          | Dihydroxy diphenyl sulfone       | 377D         |
| Liperic                             | 144I         | 3-Dimethylaminopropylamine       | 134-5e       |
| Methacrylic, glacial                | 376C         | 3-Di-n-butylaminopropylamine     | 134-5g       |
| Silica S L                          | 376D         | Dispersants                      | 377E         |
| Sorbic                              | 144H         | Emulsifiers, pesticide           | 144E         |
| Stearic                             | 376E         | Ethyl benzene                    | 377F         |
| Sulphuric                           | 107c         | Ethyl mercaptan purified         | 377G         |
| Thiomalic                           | 376F         | Extenders                        | 377H         |
| Acrylamide                          | 376G         | Flavors                          | 377I         |
| Acrylic copolymer emulsions         | 376H         | Formaldehyde                     | 139a, 247    |
| Additives                           | 376I         | Greases                          | 281, 377J    |
| Adhesives, Teflon                   | 144D         | Water and heat proof             | 144J         |
| Adsorbents, selective               | 136A         | 2-Hydroxy-4-methoxy-benzophenone |              |
| Alcohol                             |              | bulletin 31                      | 134-5m       |
| Fatty                               | 376L         | 3, 3-Iminobispropylamine         | 134-5h       |
| Furfuryl                            | 376J         | Indulin                          | 377K         |
| Polyvinyl                           | 376K         | Inositol                         | 377L         |
| Alkalies                            | 107b, 279b   | 3-Isopropoxypropylamine          | 134-5i       |
| Alkyl halides                       | 376M         | Laminates                        | 144G         |
| Alumina, fused                      | 29           | Lithium aluminum hydride         | 377M         |
| Ammonia                             | 107e         | Methanol                         | 378A         |
| Anhydrous                           | 263b, 134-5b | 3-Methoxypropylamine             | 134-5j       |
| Ammonium oxalate                    | 141          | Methyl amyl acetate              | 378B         |
| Arnel                               | 144A         | Molding compounds                | 144B         |
| Bacteria, erysipelos                | 134-5k       | Molybdenum                       | 378C         |
| Benzene phosphorus dichloride       | 376N         | Niacinamide USP powder           | 378D         |
| Calcium gluconate USP powder        | 376O         | Nitrate of soda                  | 378E         |
| Carbonate potash                    | 243c         | Nitrogen compounds, fatty        | 145c         |
| Carriers, catalyst                  | 376P         | Nitrogen solutions               | 378F         |
| Catalysts                           | 376Q         | Nylon powders                    | 144F         |
| Tableted                            | 88           | Oils, industrial                 | 378G         |
| Cellulose products                  | 223b         | Oxidation derivatives of toluene | 139f         |
| Chelating agents                    | 376R         | Ozone                            | 81b          |
| Chemicals                           | 376S         | Paradichlorobenzene              | 243d         |
| Analytical                          | 259d         | Pentaerythritol                  | 139b, 378H   |
| Industrial                          | 259a         | m-Phenols                        | 144C         |
| Medicinal                           | 259b         | Phosphorous trichloride          | 378I         |
| Organic                             | 376T, 376U   | Plasticizers, vinyl              | 378J         |
| Petroleum                           | 75a          | Potash, caustic                  | 243b         |
| Photographic                        | 259c         | Preservatives                    | 378K         |
| Research                            | 376V         | Raw materials, chemical          | 279a         |
| Terpine                             | 223d         | Rayon                            | 142C         |
| Chlorinated products                | 223f         | Resin coatings                   | 121          |
| Chlorination derivatives of toluene | 139e         | Resins                           |              |
| Chlorine                            | 107d         | Acrylic                          | 213d         |
| Liquid                              | 243a         | Coumarone-indine                 | 154          |
| Coagulants                          | 142A         | Fluorothene                      | 379A         |
| Cotton, chemical                    | 223c         | Ion exchange                     | 331          |
| Cyanuric chloride                   | 134-5d       | Nylon                            | 213c         |
| Defoamers                           | R297         | Polyamide                        | 145a         |
|                                     |              | Polyester                        | 134-5c, 262D |
|                                     |              | Polyethylene                     | 213b         |

|                                      |           |
|--------------------------------------|-----------|
| Polyvinyl                            | 9         |
| Synthetic                            | 223a      |
| Tetrafluoroethylene                  | 213a      |
| Vinyl                                | 166, 379B |
| Butyral                              | 379C      |
| Retarders                            | 379D      |
| Flame                                | 379E      |
| Rosins & rosin derivatives           | 223e      |
| Salicylates                          | 139d      |
| Salicylic acid                       | 139c      |
| Silica gel                           | 73        |
| Silicone powder                      | 140B      |
| Soda ash                             | 379F      |
| Soda, caustic                        | 30, 243e  |
| Sodium hydride                       | 379G      |
| Sodium nitrate                       | 380A      |
| Softening agents                     | 380B      |
| Solvents, petroleum                  | 380C      |
| Stabilizers, mud                     | 142B      |
| Stearates, metallic                  | 380D      |
| Sulphur                              | 107a      |
| Surface active agents                | 134-51    |
| Non-ionic                            | 66A-D     |
| Surfactant selectors                 | 380E      |
| Tetrachloro phthalic anhydride       | 243g      |
| Theophylline USP anhydrous<br>powder | 380F      |
| Trichlorethylene                     | 243f      |
| Urea                                 | 263a      |
| Vitamin A                            | 380G      |
| Vitamin B1                           | 380H      |
| Zirconium hydride                    | 380I      |

## Equipment

|  |                 |
|--|-----------------|
| Absorbers, HCl, catalog S-7460                 | 167e            |
| Adhesives, epoxy resin                         | 380J            |
| Air classifying system                         | 386k            |
| Allloys & equipment, catalog 54                | 227e            |
| Alloys   | 380K            |
| Copper-silicon                                 | 153             |
| Hard-facing, catalog-Model C<br>spray-welder   | 326             |
| Nickel   | 147             |
| Nickel-base                                    | 225             |
| Nickel-chromium                                | 156             |
| Amplifiers, D-C indicating                     | 383A            |
| Analyzers                                      |                 |
| Gas, combustible                               | 383B            |
| Oxygen   | 383C            |
| Apron & grizzly feeders                        | 43g             |
| Bags, multiwall                                | 327             |
| Blenders, dry                                  | 67a             |
| Twin shell                                     | 111             |
| Blowers, centrifugal                           | 299             |
| Boiler compounds                               | 256F            |
| Boilers, verticle package, kane<br>bulletin 2K | L335            |
| Burners, Oil                                   | 382P            |
| Cables, rubber-insulated                       | 381E            |
| Capacitors, lit. B-3966A                       | 34A-Hd          |
| Caps, bubble, bulletin 21                      | TL298           |
| Castings                                       |                 |
| High alloy, Bulletin 3150-G                    | 368             |
| Stainless steel                                | 262C            |
| Castings and fittings, lead                    | 26e             |
| Centrifugals                                   | 219, TL296, 328 |

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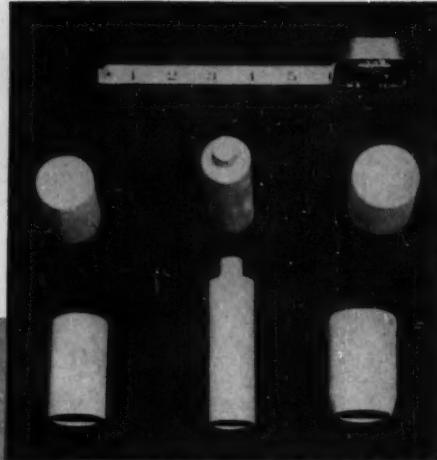
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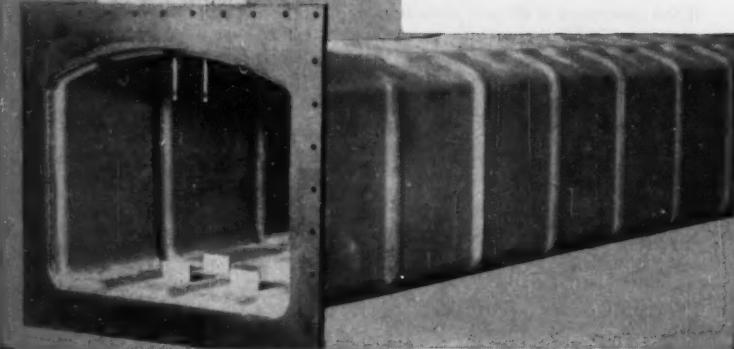
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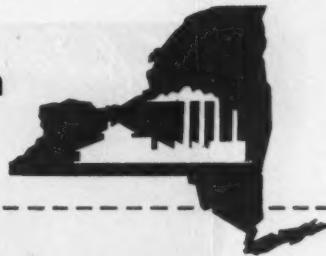
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## PRODUCT INDEX . . .

|  |            |
|--|------------|
| Bulletin 1257 . . . . .                              | 119        |
| Continuous . . . . .                                 | 389D       |
| Suspended . . . . .                                  | 389E       |
| Centrifuges . . . . .                                | 389F       |
| Chains, roller, data book 2457 . . . . .             | 89         |
| Chemical parts, hard rubber, bulletin 96-A . . . . . | 203c       |
| Chillers   |            |
| Liquid . . . . .                                     | 256C       |
| Package . . . . .                                    | 382Q       |
| Clarifiers, floatation . . . . .                     | 258B       |
| Classifiers, continuous centrifugal . . . . .        | 389G       |
| Cleaners, air . . . . .                              | 389H       |
| Cloth, filter samples . . . . .                      | TL295      |
| Coating systems, protective, bulletin MC-8 . . . . . | 265a       |
| Coatings   |            |
| Corrosion-resistant . . . . .                        | 381A       |
| Protective, bulletin VP-1 . . . . .                  | 265b       |
| Nickel . . . . .                                     | 339-40     |
| Surface . . . . .                                    | 75b        |
| Cocks, master catalog . . . . .                      | 233d       |
| Coils  |            |
| Lead . . . . .                                       | 26b        |
| Pipe . . . . .                                       | 382W       |
| Colorimeters, flow, data file 90-14 . . . . .        | 54         |
| Columns . . . . .                                    | 410b       |
| Compressors  |            |
| Balance/opposed, bulletin 118 . . . . .              | 49         |
| Centrifugal . . . . .                                | 127        |
| Two-in-one . . . . .                                 | 252A       |
| Condensers, stainless steel . . . . .                | R333b      |
| Containers, collapsible . . . . .                    | 382G       |
| Controllers  |            |
| Indicating . . . . .                                 | 383E, 383F |
| Limit . . . . .                                      | 383G       |
| Pressure drop . . . . .                              | .60        |
| Program . . . . .                                    | 383H       |
| Time cycle . . . . .                                 | 383I       |
| Control systems, combustion . . . . .                | 383D       |
| Controls   |            |
| Indicating, mercury actuated, catalog CC . . . . .   | 318        |
| Level . . . . .                                      | 383J       |
| Liquid level . . . . .                               | 161a       |
| Pressure . . . . .                                   | 161b       |
| Supervisory . . . . .                                | 383K       |
| Temperature . . . . .                                | 383L, 384A |
| Temperature and pressure . . . . .                   | 245        |
| Conveying systems . . . . .                          | 69         |
| Conveyors  |            |
| Belt, sectional . . . . .                            | 382H       |
| General catalog . . . . .                            | 329        |
| Tabular, bulletin CE-155 . . . . .                   | 330        |
| Coolers . . . . .                                    | 13b        |
| Bulletin A-422 . . . . .                             | 42b        |
| Cascade, catalog S-6820 . . . . .                    | 167d       |
| Rotary . . . . .                                     | 386h       |
| Coolers & slakers . . . . .                          | 43c        |
| Counters   |            |
| Control . . . . .                                    | 384B       |
| Flow . . . . .                                       | 384C       |
| Couplings  |            |
| Fluid . . . . .                                      | 388A       |
| Pipe . . . . .                                       | 388B       |
| Crushers . . . . .                                   | 258D, L294 |

## plant-location

### news



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|  |             |
|--|-------------|
| Jaw  | 43f         |
| Primary, gyrating                            | 43b         |
| Secondary, gyratory                          | 43d         |
| Crystallizers, vacuum,                       |             |
| Bulletin C-100                               | 92g         |
| Cyclones                                     | 389I        |
| Ceramic                                      | 258A        |
| Demineralizers                               | 389J        |
| Detectors, leak                              | 384D        |
| Diatomaceous materials                       | 51b         |
| Drives                                       |             |
| Control, spec. CAO40                         | 246a        |
| Cooling tower, gear,<br>catalog CT-53        | 253         |
| Fluid, Bulletin 144-D                        | M293        |
| Shaft mounted                                | 41          |
| Speed  | 381F, 382A  |
| Drums, steel                                 | 24          |
| Dryers                                       | 13a, 390A   |
| Adsortive, bulletin D-29                     | 231         |
| Bulletin A-422                               | 42c         |
| Centrifugal                                  | 371a        |
| Drum   | 256D        |
| Lectrodryer                                  | 25          |
| Rotary                                       | 94          |
| Double-shell                                 | 386i        |
| Single-shell                                 | 386c        |
| Rotary vacuum, catalog 341                   | 255         |
| Spray, bulletin D-106                        | 92d         |
| Steam tube                                   | 115         |
| Thermal                                      | 371b        |
| Vacuum                                       | 77          |
| Drying system, flash,<br>catalog 54-A        | 306         |
| Ducts, bus, lit. B-4272B                     | 34A-He      |
| Dust collectors                              | 235, 390B   |
| Cloth flat bag                               | 379, 316    |
| Cloth tube, bulletin 372                     | 65          |
| Bulletin 800                                 | 82          |
| Ring bag                                     | 234         |
| Model D, bulletin 302A                       | 21b         |
| Series 12, bulletin 102A                     | 21a         |
| Water wash                                   | BL295       |
| Water wash, catalog A-655                    | 211         |
| Ejectors, steam jet                          | 325         |
| Elbows, long tangent, catalog 54             | 46          |
| Engines                                      | 382B        |
| Generating, stationary                       | 163         |
| Evaporators                                  |             |
| Forced circulation, bulletin E-107           | .92b        |
| Vertical, long tube, bulletin E-100          | .92a        |
| Exhausters, rubber-lined,<br>bulletin 2424-F | 74          |
| Fabrications                                 |             |
| Metal  | 309         |
| Process equipment                            | BL333, 381B |
| Fabrics, filter                              | 162         |
| Feeders                                      | 382I, 382J  |
| Constant-weight                              | 386n        |
| Filter aids                                  | 51a         |
| Filter media                                 | 395D        |
| Filter paper                                 | 367         |
| Filters                                      | 6, 271      |
| Air, bulletin 248                            | 40          |
| Continuous, centrifugal                      | 11          |
| Continuous vacuum                            | 131         |
| Horizontal, catalog WC-1-53                  | 304         |

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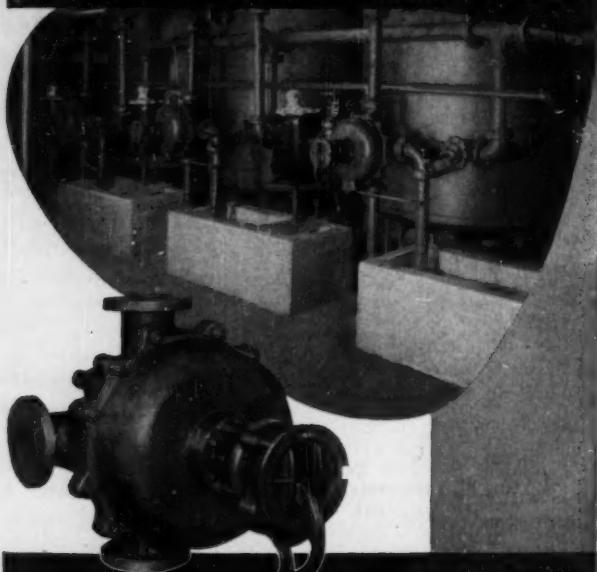
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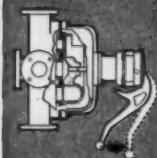
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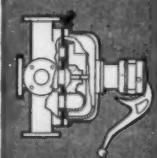
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### PRODUCT INDEX . . .

|  |                                      |
|--|--------------------------------------|
| Pilot plant . . . . .  | 381                                  |
| Plastic . . . . .  | 321                                  |
| Pressure leaf . . . . .  | 390C                                 |
| Rotary-drum, vacuum,<br>bulletin F-100 . . . . .                 | 92e                                  |
| Rotary vacuum . . . . .  | 392A                                 |
| Sand . . . . .   | 386e                                 |
| String discharge . . . . .                                       | 380                                  |
| Top-feed, bulletin F-101 . . . . .                               | 92f                                  |
| Fire extinguishers . . . . .                                     | 18                                   |
| Fittings . . . . .   | 7                                    |
| Hard rubber, bulletin 96-A . . . . .                             | 203b                                 |
| Jacketed cross . . . . .   | 254B                                 |
| Master catalog . . . . .   | 233a                                 |
| Stainless steel . . . . .  | 58                                   |
| Welding . . . . .  | 10                                   |
| Fire protection . . . . .  | 39                                   |
| Flakes . . . . .   | 148                                  |
| Flanges, forged, catalog 653 . . . . .                           | R293                                 |
| Gages . . . . .  | 233c                                 |
| Liquid level . . . . .   | 384E                                 |
| Pressure . . . . .   | 317                                  |
| Tank . . . . .   | TR335                                |
| Gaskets, Teflon . . . . .  |                                      |
| Jacketed, catalog TG-953 . . . . .                               | 324b                                 |
| Snap-on, catalog TG-953 . . . . .                                | 324a                                 |
| Generating units, steam . . . . .                                | 382R                                 |
| Generators . . . . .   |                                      |
| Steam . . . . .  | 256B                                 |
| Catalog 622-F . . . . .  | L291                                 |
| Ultrasonic . . . . .   | 384F                                 |
| Grating & stair treads, stainless steel . . . . .                | 312                                  |
| Grinders . . . . .   | 64a                                  |
| Heat exchangers . . . . .  | 19, 55a, 214-5b,<br>R333a, 382S, 323 |
| Catalog DM-1150 . . . . .  | 97                                   |
| Catalogs S-6740, S-6840 . . . . .                                | 167c                                 |
| Bulletin M/2 . . . . .   | 227a                                 |
| Scraped surface, bulletin PE-1 . . . . .                         | 85                                   |
| Heat transfer & crystallization,<br>bulletin E-106 . . . . .     | 92i                                  |
| Heaters . . . . .  | 146                                  |
| Air, literature group H54-15 . . . . .                           | M291                                 |
| Direct-fired, bulletin 104 . . . . .                             | 313                                  |
| Dielectric . . . . .   | 382T                                 |
| Gradation . . . . .  | 72                                   |
| Unit . . . . .   | M294                                 |
| Heating elements . . . . .                                       |                                      |
| Electrical . . . . .   | 382U, 382V                           |
| Resistance . . . . .   | 256E                                 |
| Homogenizers-dispersers . . . . .                                | BR332                                |
| Hose, flexible . . . . .   | 254E                                 |
| Humidity conditioning units,<br>literature group K54-2 . . . . . | 59                                   |
| Indicator-controller, temperature,<br>bulletin MC122 . . . . .   | 152                                  |
| Indicators . . . . .   |                                      |
| Gas . . . . .  | 384G                                 |
| pH . . . . .   | 277, 384H                            |
| Instruments . . . . .  |                                      |
| Data processing . . . . .  | 384I                                 |
| Spectrometer . . . . .   | 239                                  |
| Insulation . . . . .   | 237                                  |
| Glass fiber . . . . .  | 34                                   |
| Ion exchangers . . . . .   | 44                                   |
| Isolators . . . . .  | 382C                                 |
| Jacketing, aluminum . . . . .                                    | 222                                  |
| Joints, swivel, ball bearing,<br>catalog 53-C . . . . .          | 229                                  |

|  |         |
|--|---------|
| Kilns, rotary                          | 43a     |
| Bulletin A-422                         | 42a     |
| Rotary & shaft                         | 3861    |
| Lathes, glass working                  | R294    |
| Lining systems                         | 262B    |
| Linings                                |         |
| Drum, bulletin D1-2                    | 265c    |
| Sheet lead                             | 26d     |
| Linkage, control, bulletin CA942B      | .246b   |
| Load measuring elements,               |         |
| volumetric, bulletin 98232             | 150     |
| Materials of construction, clad steels | 241b    |
| Measurement                            |         |
| Dewpoint                               | 384J    |
| Oxygen                                 | 384K    |
| Measuring systems                      | 260C    |
| Meters                                 | 384L    |
| Control valve                          | 155     |
| Meters & regulators                    | 384M    |
| Microscopy, fluorescence               | 384N    |
| Mills                                  |         |
| Ball                                   | 67b     |
| Conical                                | 386b    |
| Drier                                  | .84c    |
| Grinding                               | .43e    |
| Hammer                                 | .84a    |
| Impact                                 | .84d    |
| Rod                                    | 386m    |
| Roller                                 | .84b    |
| Tricone                                | 386j    |
| Mixers, condensed catalog B-105        | 117a    |
| Data sheet B-107                       | 117b    |
| Dry-batch                              | .64b    |
| Laboratory, bulletin DH-50             | 117c    |
| Explosion-proof, bulletin              |         |
| DH-51                                  | 117h    |
| Portable                               | .67c    |
| Electric & air driven,                 |         |
| bulletin B-108                         | 117d    |
| Proportional, bulletin L               | .R296   |
| Ribbon                                 | .67d    |
| Side entering                          | .67e    |
| Bulletin B-104                         | 117e    |
| Solids                                 | 258C    |
| Top entering                           | .67f    |
| Propeller type, bulletin B-103         | 117f    |
| Turbine & paddle types,                |         |
| bulletin B-102                         | 117g    |
| Monitoring & measuring, sulphur com-   |         |
| pounds, bulletin CEC1810C-X4           | 71      |
| Monitors, liquid level                 | 386A    |
| Motors, bulletin MU-185                | 86      |
| Ball bearing                           | 45      |
| Chemical                               | 382D    |
| Integral hp                            | 83      |
| Syncogear, type GW                     | .79     |
| Unibrake, type D, data 3810            | .409    |
| Wound-rotor                            | 382E    |
| Ozonators                              | .81a    |
| Packagings                             | 382K    |
| Packings & gaskets, Teflon             | 320     |
| Packings                               |         |
| Rod & shaft, folder AD-131             | 322     |
| Saddle, bulletin IS-29                 | 98      |
| Teflon                                 | 375     |
| Pelleters, continuous                  | 90      |
| Pipe & fittings, catalog 7000          | 167b    |
| Glass, bulletins EA-I, EA-3            | .288-9b |

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M<sup>c</sup>

# Separation

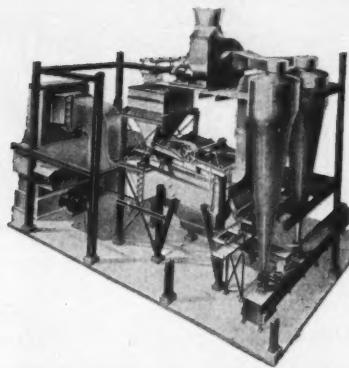


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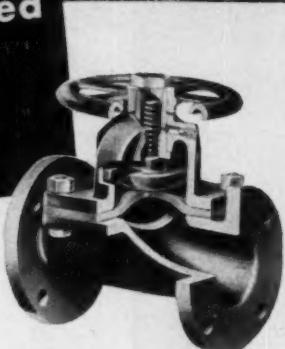
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V-11

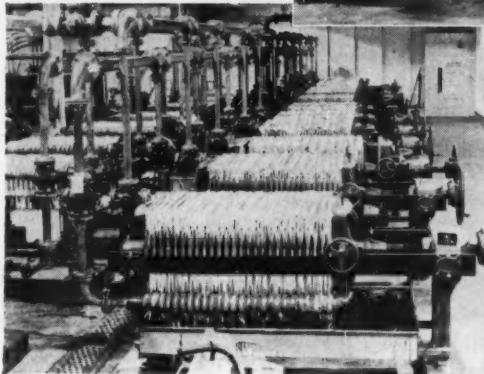
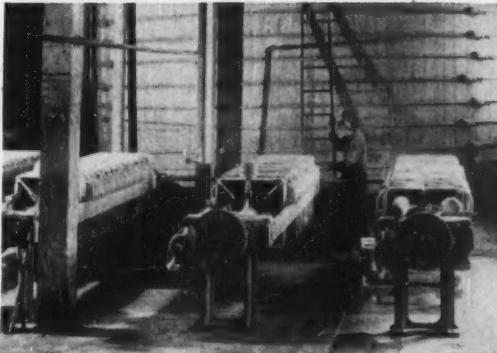
### PRODUCT INDEX . . .

|  |                  |
|--|------------------|
| Plastic . . . . .                            | 286              |
| Pipe & tubes, stainless . . . . .            | 217              |
| Pipes  |                  |
| Drain, acidproof, bulletin PF/4 . . . . .    | 227d             |
| Glass, installation, bulletin PE-3 . . . . . | 288-9a           |
| Hard rubber, bulletin 96-A . . . . .         | 203a             |
| Saran lined . . . . .                        | 32               |
| Plants, packaged . . . . .                   | 84g              |
| Platecoils, bulletin P61 . . . . .           | 50               |
| Platinum & palladium,                        |                  |
| electroplated . . . . .                      | 381C             |
| Power centers, lit. B-4162 . . . . .         | 34A-Ha           |
| Preheaters, air . . . . .                    | 87               |
| Presses, filter . . . . .                    | 35, 373          |
| Process equipment . . . . .                  | 55d              |
| Catalog 100-A-11 . . . . .                   | 386a             |
| Proportioning systems, automatic,            |                  |
| bulletin 0351 . . . . .                      | 149              |
| Pulleys, magnetic, bulletin 303-C . . . . .  | 275              |
| Pumps  |                  |
| Catalog S-7250 . . . . .                     | 167a             |
| Bulletin P11 . . . . .                       | 227c             |
| Folders SP-336C & SP-344C . . . . .          | TR332            |
| Acid . . . . .                               | 17               |
| Canned rotor . . . . .                       | 53               |
| Centrifugal . . . . .                        | 394C, 394D, 394E |
| Bulletin P-3a . . . . .                      | 22-3             |
| Bulletin W-350-B16 . . . . .                 | 158              |
| Self-priming . . . . .                       | 168              |
| Chemical . . . . .                           | 57               |
| Bulletin 725.4 . . . . .                     | 319              |
| Double suction . . . . .                     | 383              |
| Metering & proportioning,                    |                  |
| bulletin AP-54 . . . . .                     | 394F             |
| Piston-diaphragm, bulletin 300 . . . . .     | 62               |
| Process, bulletin 1125-B . . . . .           | 33               |
| Proportioning . . . . .                      | 101              |
| Sanitary . . . . .                           | 395A             |
| Submersible well . . . . .                   | 254A             |
| Turbo . . . . .                              | 254D, 395B       |
| Vacuum, bulletin 400 . . . . .               | 125              |
| Vertical, bulletin V-837 . . . . .           | L293             |
| Purifiers . . . . .                          | 395C             |
| Reactors . . . . .                           | 214-5c           |
| Solid-contact . . . . .                      | 392B             |
| Recorders & controllers . . . . .            | 386B, 386C       |
| Bulletin 7201 . . . . .                      | 14-5             |
| Recorders, temperature . . . . .             | TL333            |
| Reducers, speed . . . . .                    | 382F             |
| Reformers . . . . .                          | 48               |
| Regulators, temperature,                     |                  |
| bulletin T500 . . . . .                      | 63               |
| Respirators . . . . .                        | 164              |
| Chemical cartridge . . . . .                 | 395H             |
| Retorts, bulletin A-422 . . . . .            | 42d              |
| Rings, carbon packing . . . . .              | 16               |
| Roasters . . . . .                           | 13c              |
| Rotameters, bulletin 18-RG . . . . .         | 68               |
| Rubber, fibrous . . . . .                    | 140A             |
| Sampling systems . . . . .                   | 386D             |
| Scales                                       |                  |
| Automatic . . . . .                          | BL296            |
| Filling . . . . .                            | 382L             |
| Platform . . . . .                           | 382M             |
| Screens, vibrating . . . . .                 | 84f              |
| Scrubbers, conical . . . . .                 | 386g             |
| Seals . . . . .                              |                  |

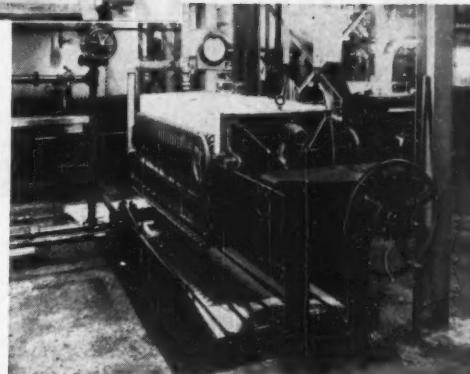
# JOBs for FILTER PRESSES that improve processing

|                                  |                |
|----------------------------------|----------------|
| Mechanical                       | 377            |
| Teflon, bulletin MS-954          | 310            |
| Selectors, stainless steel       | 257            |
| Separators                       | L332           |
| Air                              | 84e            |
| Centrifugal                      | 392C           |
| Flootation                       | 392D           |
| Magnetic                         | 384            |
| Catalog 870                      | 61b            |
| Bulletin 16-E                    | R298           |
| Separators & classifiers         | 386f           |
| Servo systems                    | 386E           |
| Shell-ice makers                 | 382X           |
| Siphons, jet                     | 254C           |
| Softeners                        |                |
| Hot process                      | 394A           |
| Zeolite, publication 4520-A      | L334           |
| Spray drying equipment,          |                |
| bulletin D-105                   | 92c            |
| Sprayers, hot                    | 264C           |
| Starters                         |                |
| Automatic, bulletin 712          | 66b            |
| Circuit breaker, bulletin 713    | 66d            |
| Motor                            | 66a            |
| Solenoid, bulletin 709           | 66c            |
| Steels                           |                |
| Clad                             | 241a           |
| Stainless                        | 96a, 170, 381D |
| ELC                              | 96b            |
| Tube                             | 337            |
| Steril-Aqua systems              | 394B           |
| Strainers                        |                |
| Fine screen, bulletin S-204      | 95             |
| Rotary                           | R295           |
| Switchgears, metal-clad,         |                |
| literature B-5306A               | 34A-Hc         |
| Tank cars, fluid dome            | 207            |
| Tanks                            |                |
| Field-erected                    | 93a            |
| Glassed steel                    | 410a           |
| Lead bonded                      | 26a            |
| Stainless, clad                  | 133            |
| Storage                          | 36a            |
| Truck                            | 36b            |
| Testers, magnetic thickness      | 386F           |
| Thermocouple                     | 260A           |
| Elements                         | 386G           |
| Thermometers, maxivision dial    | 278            |
| Thermo-Panels                    | B404           |
| Thermoscrews                     | BR335          |
| Thickness-clarifiers             | 386d           |
| Thread compounds                 | 264B           |
| Towers                           | 55c, 93b       |
| Tractor-shovel attachments       | 382N           |
| Trailers, gas supply             | BL297          |
| Transducers                      | 386H           |
| Transformers, literature B-4249A | 34A-Hb         |
| Transmissions, ball              | 248A           |
| Transmitters, pressure           | 260D           |
| Transport bodies, bulk           | 382O           |
| Traps, steam                     | 256A, 382Y     |
| Steam & air                      | 382Z           |
| Trays, bubble, bulletin 154      | 308            |
| Tube removal                     | 264A           |
| Tubes                            |                |

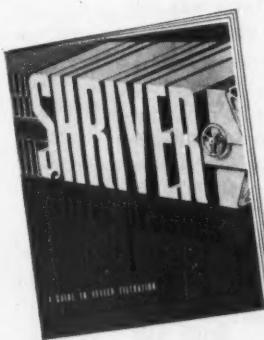
Recovery of firm filter cake free of soluble salts as in this Shriver installation for colors and pigments. The presses are equipped with individual outlet cocks for controlling flow of wash water to individual filter chambers.



Filtration of viscous materials as in this battery of Shriver filter presses for rayon, which permit using inexpensive, throw-away filter medium, reducing operating costs.



Filtration requiring high degree of clarity, as in the purification of edible oils in this Shriver filter press, where filter paper or pads are conveniently used.



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## PRODUCT INDEX . . .

|  |                  |
|--|------------------|
| Condenser  | 151              |
| Duplex   | 20               |
| Stainless  | 269              |
| Tubing & line pipe, fibercast                            | 388C             |
| Tubing, stainless & high alloy                           | 157              |
| Turbines, solid-wheel, bulletin S-116                    | 37               |
| Unions   |                  |
| Forged, stainless steel, catalog 55                      | BL298b           |
| Forged, steel, catalog 55                                | BL298a           |
| Valves   | 233b, 251        |
| Automatic, bulletin 700                                  | R336             |
| Bronze   | R284             |
| Butterfly  | 314              |
| Check, bulletin P-I                                      | 385              |
| Clamp gate   | 305              |
| Control, bulletin 103-B                                  | 169              |
| Diaphragm  | 8, 372           |
| Discharge  | 388D             |
| Fog & deluge   | 388F             |
| Gate, catalog 10   | 276              |
| Cast steel   | 47               |
| Lead & lead lined  | 26c              |
| Lubricated plug  | 261              |
| Multi-port   | 370              |
| Relief   | 389A             |
| Nickel-iron, bulletin 118                                | 76               |
| Non-lubricated, steel plug                               | 70a              |
| Plug, catalog 5  | 28               |
| Porcelain  | 38               |
| Pressure-seal, circular 143                              | 285              |
| Safety   | 36c, 389B        |
| Safety shut-off  | 389C             |
| Standard   | 338              |
| Type F, bulletin V14                                     | 227b             |
| Union check, catalog 55                                  | BL298c           |
| Valve & fittings   | 70b, 388E        |
| Vaporizers, dowtherm, bulletin A-100                     | L336             |
| Vermiculite concrete                                     | 262A             |
| Vessels, pressure  | 55b, 93c, 214-5a |
| Vibrating equipment, catalog 870                         | 61a              |
| Vibrators  |                  |
| Air & electric   | R334             |
| Concrete   | 315              |
| Washers, pulp, bulletin E-108                            | 92h              |
| Weighing systems, booklets 4106 & 4105                   | 80               |
| Welding  |                  |
| Arc  | 264D             |
| Copper   | 267              |
| Weldments  | 91               |
| Wire cloth   | 311              |
| Catalog E  | 378              |
| Wire mesh  | TL297            |
| Services   |                  |
| Chemical cleaning service                                | 27               |
| Engineering & construction                               | 52, 113          |
| Engineering & design                                     | 221              |
| Process plants, brochure 101                             | 160              |
| CO <sub>2</sub> Engineering service, grinding operations | 249              |
| Maps, physical   | 395E             |
| Plant layout   | 395F             |
| Plant location   | 369              |
| Processes, petrochemical                                 | 129              |
| Processing materials, chemical                           | 223g             |
| Protection guide, hazardous gases                        | 395G             |
| Research, metallurgical                                  | 214-5d           |

## Flashback

To make sure that you don't miss any news that could help you with your job, Chemical Engineering is doing a double take for you. The index below repeats the editorial listings only on chemicals, equipment and services featured last month in New Equipment and New Products. Use the postcard (p. 449) for more information on any items.

### Chemicals

|  |      |
|--|------|
| Ammonium nitrate . . . . .                   | 146A |
| Binders, for glass mats . . . . .            | 150H |
| Ceramics in solution . . . . .               | 148C |
| Detergents, industrial . . . . .             | 146D |
| Diatomaceous iodine . . . . .                | 150I |
| Diisocyanates . . . . .                      | 144A |
| Grease, all purpose . . . . .                | 150K |
| Hypertension drug . . . . .                  | 150F |
| Infiltrase . . . . .                         | 150J |
| Isobutylaldehyde . . . . .                   | 140A |
| Oil well openers, explosive charge . . . . . | 146C |
| Pigments, universal . . . . .                | 150A |
| Plastic laminates . . . . .                  | 150E |
| Plasticizers, lighter colored . . . . .      | 150B |
| Polymeric latices . . . . .                  | 150D |
| Rubber softeners . . . . .                   | 150G |
| Rust Remover . . . . .                       | 148B |
| Silica, super-fine . . . . .                 | 146B |

### Equipment

|   |            |
|---|------------|
| Analyzers, oxygen . . . . .                 | 260B       |
| Circulator, gas . . . . .                   | 250A       |
| Coatings                                    |            |
| Glass cloth . . . . .                       | 148A       |
| Protective . . . . .                        | 264C       |
| Cyclones, revamped . . . . .                | 252A       |
| Gages, electronic tank . . . . .            | 258D       |
| Generators, ultrasonic . . . . .            | 250B       |
| Heaters                                     |            |
| Electric . . . . .                          | 256B, 256D |
| Hot oil . . . . .                           | 256A       |
| Hygrometers, dew point . . . . .            | 260A       |
| Indicators, explosion-proof level . . . . . | 260E       |
| Insulating rope . . . . .                   | 264E       |
| Machine, cleaning . . . . .                 | 254C       |
| Meters, magnetic flow . . . . .             | 258A       |
| Packings, sheet . . . . .                   | 254B       |
| Paints, heat resistant . . . . .            | 144B       |
| Panels, heating . . . . .                   | 256C       |
| Pellet cutters . . . . .                    | 252C       |
| Pipe, plastic . . . . .                     | 262B       |
| Protected storage . . . . .                 | 252D       |
| Pumps                                       |            |
| Graphite . . . . .                          | 262C       |
| Proportioning . . . . .                     | 262E       |
| Two-stage . . . . .                         | 262A       |
| Siding, industrial . . . . .                | 264D       |
| Steels, stainless . . . . .                 | 264B       |
| Suits, protective . . . . .                 | 254A       |
| Testers, hardness . . . . .                 | 258B       |
| Thickeners, high capacity . . . . .         | 248A       |
| Titanium alloys, heat proof . . . . .       | 150C       |
| Tools, pipe fitting . . . . .               | 254D       |
| Transducers . . . . .                       | 260C       |
| Transmitters                                |            |
| Pressure . . . . .                          | 260F       |
| Traps, bucket . . . . .                     | 256E       |
| Valves, stainless steel . . . . .           | 262D       |
| Veneers, ceramic . . . . .                  | 264A       |
| Water softeners . . . . .                   | 252B       |



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## What It Contains . . .

This is a comprehensive listing of the latest literature you can now get from manufacturers on chemicals, equipment and services in all fields of interest to chemical engineers. It lists new publications just issued as well as all bulletins mentioned in this issue. For your convenience, all items have been categorized and alphabetized.

## For More Information . . .

You can get—and get fast—more information on any publication listed in this guide by using the Reader Service postcard inside the back cover. Simply circle the item's code number on the postcard, fill in your name and address, then mail to us. Ask for as many as you need. Answers come to you direct from the companies putting out the literature.

## Contents of This Issue . . .

|                             |     |
|-----------------------------|-----|
| Chemicals and materials     | 376 |
| Construction materials      | 380 |
| Electrical equipment        | 381 |
| Handling and packaging      | 382 |
| Heating and cooling         | 382 |
| Instruments and controls    | 383 |
| Mechanical equipment        | 381 |
| Pipe, fittings, valves      | 388 |
| Process equipment           | 389 |
| Pumps, blowers, compressors | 394 |
| Services and Processes      | 395 |

# Guide to Technical Literature

Want to build up your files and keep them up-to-date? This comprehensive guide to available literature will help you do just that. They're yours—free—for the asking.

## Chemicals

**Acetic Anhydride**.....Features high purity...by the drum or by the tank car...delivered promptly. For complete information on this product and other anhydrides produced, request new Booklet No. F-5280A.  
376A      Carbone & Carbon Chem.

**Acid, Benzene Phosphonic**.....Suggested uses: solid acid; intermediate for forming metallic salts used as anti-fouling agents for paints; catalyst for urea formaldehyde and related resins. Offers a product sample.  
376B      Victor Chem. Wks.

**Acid, Methacrylic, Glacial**.....18 p. descriptive Bulletin provides information regarding: availability and containers; typical properties and specifications; handling; removal of inhibitor by distillation; etc.  
376C      Reim & Hans Co.

**Acid, Silicic SL**.....Fine, white, bulky powder; odorless. Used in the manufacture of silicate phosphors for fluorescent and television tubes. Offers complete details in company's Technical Information Sheet.  
376D      Mallinckrodt Chem. Wks.

**Acid, Stearic**.....Develops a new triple pressed stearic acid—Neo-Fat 18-55—to give you higher quality at no increase in price. Features advantages of heat and color stability. Product samples made available.  
376E      Armour Chem. Div.

**Acid, Thiomalic**.....Only commercially available dicarboxylic acid containing a reactive mercapto group as well as 2 carboxyl groups. Covers properties in addition to 40 literature references. Technical Bulletin No. 1-9.  
376F      National Antiline Inc.

**Acids, Fatty**.....Mineral ore output by froth flotation is on the increase, & General Mills assisted in the development with Aliphatics specifically designed for ore flotation. Full data on inexpensive fatty acids.  
145b      General Mills.

**Acrylamide**.....Cyanamid's acrylamide now available in semi-commercial quantities for use in adhesives...fibers...graphic arts...leather...plasticizers...etc. Offers New Product Bulletin & sample.  
376G      American Cyanamid Co.

**Acrylic Copolymer Emulsions**.....Makes available a new comprehensive brochure covering acrylic copolymer emulsions. Shows you how to take advantage of company's personalized polymer service. Brochure P-57.  
376H      American Polymer Co.

**Additives**.....New sodium borate product—FR-28—has been specifically developed for use as an additive for your latex-base paint composition to produce a coating that is flame-resistant. Offers Bulletins 6-F, FR-28.  
376I      Pacific Coast Borax Co.

**Alcohol, Furfuryl**.....Derived from agricultural residues & useful in manufacture of wide variety of products including resinous mortars, cements, binder resins, etc. Data on properties & uses in Bulletin No. 205.  
376J      Quaker Oats Co.

**Alcohol, Polyvinyl**.....Rigidly controlled for uniformly high quality. Free-flowing and fast-dissolving—white and non-gelling. A dependable source for quick delivery. Furnishes complete data and product samples.  
376K      Colton Chem. Co.

**Alcohols, Fatty**.....Ethoxylated, these Makanols provide outstanding advantages as emulsifiers and for use as non-ionic detergents. Company offers fully descriptive information plus valuable product samples.  
376L      Stepan Chem. Co.

**Alkyl Halides**.....New Technical Bulletin describes the alkyl chlorides of various chain lengths (Myristyl, C-14, Cetyl, C-16, and Stearyl, C-18). Find use in manufacture of quaternary ammonium compounds.  
376M      Aceto Chem. Co.

**Benzene Phosphorus Dichloride**.....Mol. Wt. 179. Sp. Gr. 1.315 at 25°C. B.P. 224.6°C. at atmospheric pressure. A colorless liquid which fumes in air. Intermediate in organic synthesis. Makes available product sample.  
376N      Mallinckrodt Chem. Wks.

**Calcium Gluconate USP Powder**.....An ingredient in many pharmaceutical preparations. Calcium gluconate is used almost exclusively for treatment of calcium deficiency in humans & animals. Technical Information Sheet.  
376O      Mallinckrodt Chem. Wks.

**Carriers, Catalyst**.....4 p. illustrated Folder concisely describes the advantages of Celite diatomite catalyst carriers—such as uniformity, microporosity, low density, thermal stability and great surface area.  
376P      Johns-Manville.

**Catalysts**.....Company issues a new Bulletin furnishing technical information on their M-S catalyst...which is the synthetic cracking catalyst in microspherical form. Includes physical and catalytic properties.  
376Q      Davison Chem. Co.

**Chelating Agents**.....Offers valuable reprint, "Uses of Chelating & Sequestering Agents in Cosmetics," which contains a technical discussion on chelating agents, their structure & properties. Request your copy.  
376R      Glyco Products.

**Chemicals**.....34 p. covers the physical properties for company's line of alcohols, glycols and triols, acetals, plasticizers, esters, ketones, ethers and oxides, glycol-ethers, hydrocarbons, etc. Bulletin No. F-6136H.  
376S      Carbide & Carbon Chem.

**Chemicals, Organic**.....1954 catalog, "Organic Chemicals," offers full information on Daxad dispersing agents & Darez copolymer latices—polyvinyl acetate emulsions—Everflex emulsions—plasticizers—etc.  
376T      Dewey & Almy Chem. Co.

**Chemicals, Organic**.....Company announces the availability of informative literature—"Organic Chemicals." SC: 53-18...a catalog which offers data on their complete line of solvents, intermediates and resins.  
376U      Shell Chem. Co.

**Chemicals, Research**.....Issues a new catalog of research chemicals of animal origin containing several new items. Includes data on Acylase, Tech.; 1-Aldrochrome, Crystallized; H.S.C. Lipids; etc. Catalog No. 7.  
376V      Armour & Co.

**1, 2-Dichloroethylene**.....Announces the availability of a new Technical Data Report covering the physical and chemical properties and various reactions of 1, 2-dichloroethylene (mixed cis and trans isomers).  
377A Monsanto Chem. Co.

**Diethyl Malonate**.....34 p. Technical Data Bulletin describes this useful intermediate in general organic synthesis. Covers data on properties, specifications, packaging, reactions with alkoxy compounds, etc.  
377B Kay-Fries Chem.

**Diethylene Triamine**.....Make new & better products with diethylene triamine—synthetic rubber...surface coatings...textile specialties...metal and metal working...etc. Reference No. F-8163.  
377C Carbide & Carbon Chem.

**Dihydroxy Diphenyl Sulfone**.....Shows promise as an ingredient in production of heat-resistant epoxy and phenolic resins. Covers properties, specifications, chemical reactions, uses, etc. Bulletin No. 0-118.  
377D Monsanto Chem. Co.

**Dispersants**.....Describes Marasperse—the low cost, highly effective dispersant. Completely soluble in water; non-hygroscopic, non-fermenting, non-caking, free flowing powder. Details contained in File No. W-120.  
377E Marathon Corp.

**Ethyl Benzene**.....Information provided on physical, chemical and physiological properties; specifications; shipping container contents; suggested applications; typical reactions; etc. 4 p. Technical Bulletin F-8596A.  
377F Carbide & Carbon Chem.

**Ethyl Mercaptan Purified**.....Warning agent for numerous purposes, particularly as an additive in natural and liquified fuel gases. Full data on clear, colorless, volatile liquid in Technical Information Sheet.  
377G Mallinckrodt Chem. Wks.

**Extenders**.....Halowax product 4004 is especially useful as low-cost extender in plasticizing systems for vinyl resins. Description, properties, typical formulations using product 4004, etc. Technical Bulletin No. 1.  
377H Bakelite Co.

**Flavors**.....72 p. "double" Brochure describes the D&O complementary lines of Spisorigin and Spisorama seasonings. Valuable reference includes information concerning manufacture, application, advantages, etc.  
377I Dodge & Olcott

**Formaldehyde**.....Features 4 specialized types—Formalin, Paraformaldehyde, Formcel, Trioxane—designed to meet specific needs. The right one can give you the competitive edge. Offers details on product line.  
247 Celanese Corp. of America

**Greases**.....Mo-Silicone Vacuum Grease combines unique chemical inertness & excellent temperature-viscosity relationship of silicone liquids with lubricating qualities of molybdenum disulfide. Bulletin No. 25-A.  
377J Lockrey Co.

**Indulin**.....A precipitant for proteins, enzymes, and related nitrogenous materials. Company makes available a booklet entitled, "Removal and Recovery of Proteins and Enzymes." Technical Bulletin No. 105-A.  
377K West Virginia Pulp & Paper.

**Inositol**.....Recognized as a significant nutritional factor...inositol has important relationships to cholesterol and fat metabolism. Find complete information on company's Argo Brand in their latest product booklet.  
377L Corn Products Refining Co.

**Lithium Aluminum Hydride**.....8 p. covers valuable data: molecular weight; color & form; stability; solubility; chemical reactions—inorganic; chemical reactions—organic; handling & use; etc. Bulletin No. 401.  
377M Metal Hydrides.

## HANDLING CORROSIVES

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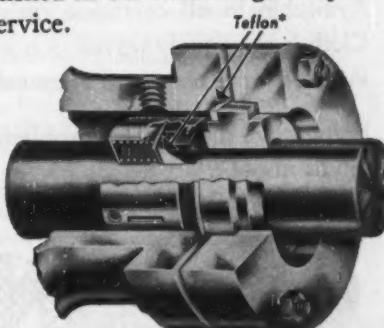


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Get complete information on the Type 9 Seal from Crane Packing Co., 1809 Belle Plaine Ave., Chicago 13, Ill.

In Canada: Crane Packing Co., Ltd., 617 Parkdale Ave., N., Hamilton, Ont.

\*DuPont trademark



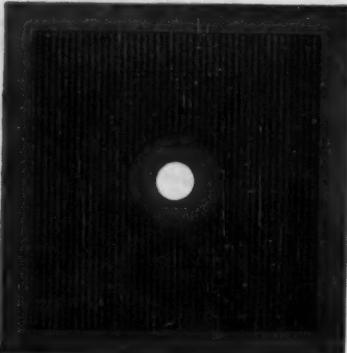
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## LITERATURE . . .

**Methanol** . . . . Supplies valuable information on Du Pont methanol—specifications, properties, uses, bibliography, etc.—including copy of new pamphlet entitled, "Methanol—The Chemical with 1000 & 1 Uses." 378A E. I. du Pont de Nemours.

**Methyl Amyl Acetate** . . . . One of most effective extraction solvents in recovery & purification of penicillin. Boils at 146.30°C. at 760 mm. Hg. Relative evaporation rate 47 (butyl acetate=100). Samples & data. 378B Carbide & Carbon Chem.

**Molybdenum** . . . . A guide to selection of molybdenum products for applications in chemical process industries. Covers briefly commercially available products, their manufacture & principal uses. Bulletin No. Ch-1. 378C Climax Molybdenum Co.

**Niacinamide USP Powder** . . . . Features valuable uses: in pharmaceutical preparations; as a specific for treatment of pellagra; to enrich various food products; etc. Complete data in Technical Information Sheet. 378D Mallinckrodt Chem. Wks.

**Nitrate of Soda** . . . . Coarse, medium or fine crystals, screened to suit your particular end use or process—whether explosives, meat packing, ceramic, dye making, food manufacture, etc. Valuable product samples. 378E Allied Chem. & Dye Corp.

**Nitrogen Compounds, Fatty** . . . . Furnishes a line of fatty nitrogen compounds. These compounds are of benefit in flotation of phosphate, potash, feldspar, and (potentially) iron ore. Offers complete technical data. 145e General Mills.

**Nitrogen Solutions** . . . . Contents include general description, crystallization temperatures, shipping and storage containers, safety precautions, first-aid measures, etc. Complete details in Technical Data Sheet No. 1. 378F Commercial Solvents Corp.

**Oils, Industrial** . . . . Armax oils in lubricants solve cold weather and hot water problems. Company offers upon request valuable samples of Armax LFO and Armax ATO—in addition to their Industrial Oil Booklet. 378G Armour Chem. Div.

**Pentaerythritol** . . . . Answers need of alkyl resin manufacturers for a pentaerythritol that qualifies for every application. New Bulletin gives full story, backed by formulations, tests, comparisons & cost analyses. 378H Celanese Corp. of America.

**Phosphorus Trichloride** . . . . Clear, colorless liquid. Uses: chlorinating agent in organic synthesis; intermediate in production of phosphites, organic chemicals. Company makes available valuable product sample. 378I Victor Chem. Wks.

**Plasticizers, Vinyl** . . . . Describes HB-20—a partially hydrogenated alkyl-aryl hydrocarbon developed primarily to meet large demand for a low cost extender type plasticizer for vinyl. Technical Bulletin No. O-P-153. 378J Monsanto Chem. Co.

**Preservatives** . . . . Highly effective preservative (bactericidal-fungicidal) for water-based paints and coatings . . . industrial emulsions . . . latex. Light in color, practically odorless. Samples and literature. 378K Guardian Chem. Corp.

**Resins** . . . . Unmatched for outdoor durability by other vinyl solution resins, Exxon 471 assures protective coatings with superior weathering & aging qualities—plus chemical resistants. Complete data on line. 166 Firestone Plastics Co.

**Resins** . . . . Epon resin coatings based on the XA-200 formulation . . . find outstanding success in the chemical process industries. Brochure covers full Epon coatings story—"Planning to Paint a Pyramid?" 121 Shell Chem. Corp.

**Resins, Coumarone-Indene**.....The special pale, low-odor coumarone-indene resin... prescribed for freeze-thaw stable PVAc emulsion paints... features valuable cost-saving advantages. Request samples & data.  
154 Neville Chem. Co.

**Resins, Fluorothene**.....Presents technical data on line of fluorothene resins. Includes history, chemical structure, properties, fabrication, applications, etc. Full information in 16 p. Booklet No. J-739.  
379A Bakelite Co.

**Resins, Ion Exchange**.....Explore catalysis with Nalcite ion exchange resins for increased yields... processing shortcuts... continuous or batch process... added safety... lower costs... etc. Technical Bulletin.  
331 National Aluminate Corp.

**Resins, Polyamide**.....Company's line of polyamide resins may be applied as heat-seal adhesive, by either hot melt or solvent solution technique. They bond at moderate temperatures. Complete technical information.  
145a General Mills.

**Resins, Polyethylene**.....Tough, flexible Alathon polyethylene resin stands up well against abrasive slurries. Widely used in industrial pipe applications. Offers complete data on the properties & applications.  
213b E. I. du Pont de Nemours.

**Resins, Tetrafluoroethylene**.....Teflon tetrafluoroethylene resins used extensively in process industries. Offer chemical inertness, high heat resistance, low-temperature toughness, etc. Properties & uses.  
213a E. I. du Pont de Nemours.

**Resins, Vinyl**.....12 p. illustrated reference offers valuable data on Geon resins 404HI & 103EP—vinyl chloride resins which provide numerous advantages for easy processing into rigid shapes. Service Bulletin G-14.  
379B B. F. Goodrich Chem. Co.

**Resins, Vinyl Butyral**.....These resins were developed to meet the need for a better safety glass laminating adhesive film. Data on properties, solubility, compatibility, etc. in 28 p. Technical Release No. 11.  
379C Bakelite Co.

**Retarders**.....Pertinent technical information concerning company's Retarder TCM-25. Includes a complete description, background material, chemical composition, toxicity, flammability, etc. Tech Bulletin No. 1.  
379D Binney & Smith.

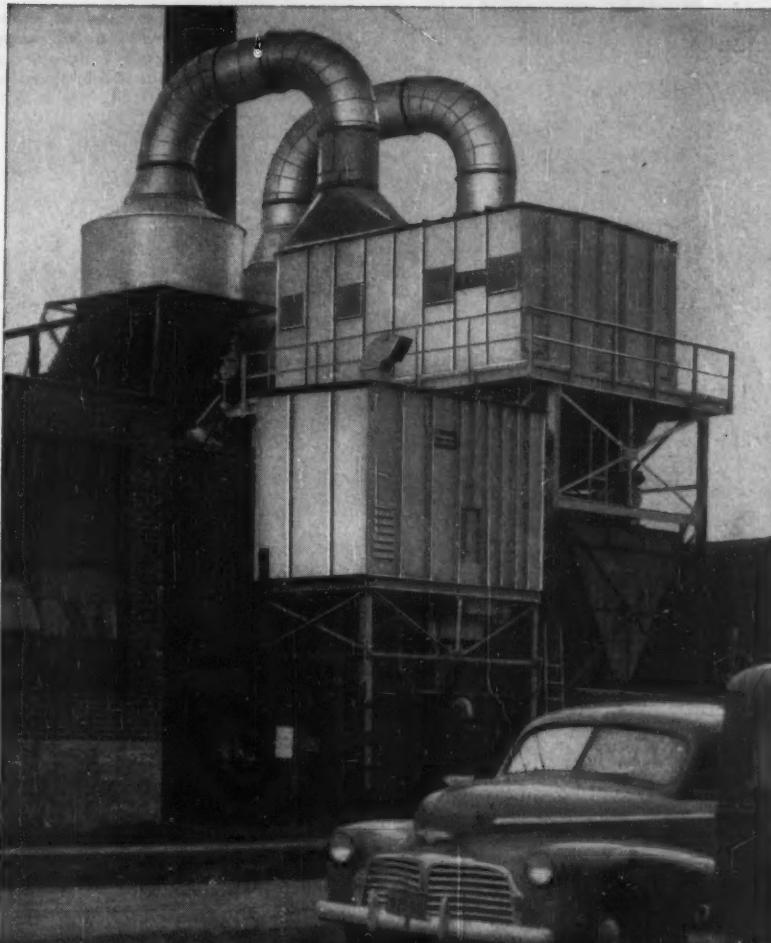
**Retarders, Flame**.....Recently developed antimony compound for use with chlorine-containing materials makes vinyls self-extinguishing. Economical to use—initial cost is low. Data Sheet offers detailed information.  
379E Metal & Thermit Corp.

**Silica Gel**.....Highly porous pure silica gel of extremely low density. Chemical & physical characteristics make it adaptable for many uses. Company provides complete information, suggested applications, etc.  
78 Davison Chem. Co.

**Soda Ash**.....Air-separation gives West End ash exceptional uniformity of particle size and density resulting in outstanding free-flowing characteristics. Provides samples, prices and technical information.  
379F West End Chem. Co.

**Soda, Caustic**.....Presents new pocket-size booklet, "Caustic Soda Buyer's Guide." Contains helpful facts on economics of 50% and 73% solutions; other forms of caustic soda; capacities of tank car; etc.  
30 Hooker Electrochem. Co.

**Sodium Hydride**.....Includes pertinent data: molecular weight; crystalline form & color; density; typical analysis; melting point; heat of formation; heat of reaction with water; etc. 7 p. Bulletin No. 507.  
379G Metal Hydrides.



### Pangborn shows Daystrom

## HOW TO SOLVE A DUST PROBLEM

Back in the '30s, when Daystrom Co., Olean, N.Y., expanded into the production of tubular steel chairs and tables, dust became a major problem. Many of the new manufacturing processes created dust, jeopardizing employee health and community goodwill.

Daystrom moved quickly to solve that problem—and Pangborn Dust Control was the solution. Pangborn has implemented good community relations and improved employee health and morale.

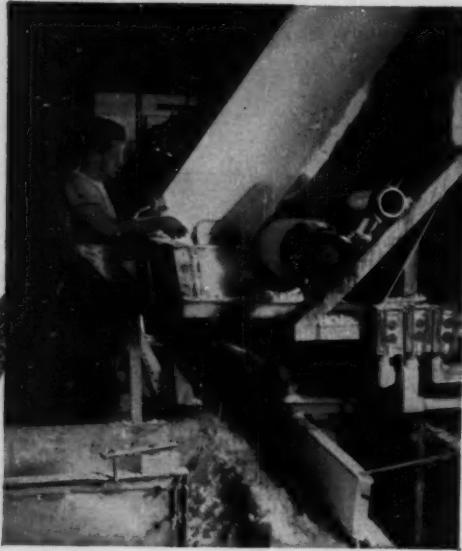
In addition, Pangborn still saves Daystrom money every year by reducing dust damage to machinery, cutting repair bills and downtime, and lowering plant maintenance costs.

Pangborn can do the same for you. Pangborn engineers will be glad to show you how Pangborn Wet or Dry Dust Collectors can solve your dust problem and save you time, trouble and money!



See how Pangborn benefits all industries. Write for free copy of "Out of the Realm of dust," Pangborn Corp., 2600 Pangborn Blvd., Hagerstown, Maryland.

# Pangborn CONTROLS DUST



Continuous sheet of sticky, dewatered hydrogel, neatly lifted from filter drum at top right, is carried by strings to discharge roll, falls to conveyor.

## YOU CAN PUT ALMOST ANY FILTER CAKE ON FEinc STRINGS

The FEinc String Discharge Filter . . . the original rotary vacuum string filter . . . easily handles thin soupy slimes, heavy sludges, coarse granules or fibres, sticky gels . . . almost any type of cake. The strings pick the cloth clean. The cloth does not smear and plug . . . you get more filtration per foot with FEinc. Blow-back is completely unnecessary, hence there's no wire winding. There's no scraping wear, hence cloths last two to five times longer. Cloth changing takes less time, too. The strings actually help. String life is excellent.

These are just a few of the reasons why, in a surprising number of cases, this FEinc is the most economical of all filters for the "easy" jobs as well as the tough ones.

The string filter is only one of many types of continuous filters now made by FEinc . . . backed by 35 years of experience . . . with proved ability to deliver tailor-made filters at no more than standard costs. Write or phone for details.

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### LITERATURE . . .

**Sodium Nitrate** . . . Features quality sodium nitrate. Danitra double refined USP Grade contains not more than 0.05% chlorides . . . 0.05% sulphates . . . 0.10% moisture. Offers product samples and price data.  
**380A** Davies Nitrate Co.

**Softening Agents** . . . Company's new softening agent—Arquard 2HT—gives a soft finish to all fabrics . . . natural and synthetic. Makes available a Technical Bulletin with complete data plus a product sample.  
**380B** Armour Chem. Div.

**Solvents, Petroleum** . . . Manufacturer makes available a Buyers' Guide to petroleum solvents and their properties. Lists aliphatic naphthas, paraffinic hydrocarbons and aromatic hydrocarbons and solvents.  
**380C** American Mineral Spirits.

**Stearates, Metallic** . . . Furnishes completely illustrated Technical Booklet on metallic stearates . . . the latest source of information about the uses and benefits of stearates and associated chemicals. 26 p.  
**380D** Synthetic Products Co.

**Surface-Active Agents, Nonionic** . . . 100%-active nonionic surface-active agents offer over-all balance of desirable properties; ease of formulation, stability, controlled sudsing, etc. Samples & Data Sheets.  
**380E** Wyandotte Chem. Corp.

**Surfactant Selectors** . . . Atlas HLB Selector helps emulsion formulator by providing a ready reference to recommendations on Atlas surfactants & HLB values for 96 typical emulsion formulas. Selectors on request.  
**380F** Atlas Powder Co.

**Theophylline USP Anhydrous Powder** . . . For use in manufacture of preparations containing theophylline as the main ingredient and for the manufacture of solubilized mixtures. Data in Technical Information Sheet.  
**380G** Mallinckrodt Chem. Wks.

**Urea** . . . Urea and anhydrous ammonia for industry and agriculture. Company's new \$20,000,000 plant near Memphis, Tenn., is progressing rapidly toward completion. Fully illustrated Brochure offers complete data.  
**380H** Grace Chem. Co.

**Vitamin A** . . . 36 p. illustrated. Spiral-bound Technical Brochure describes Roche dry vitamin A acetate. Covers biological availability, particle sizes, physical properties, analytical methods, assays, etc.  
**380I** Hoffman-La Roche.

**Vitamin B<sub>1</sub>** . . . Makes available Technical Information Sheet covering thiamine hydrochloride USP powder (vitamin B<sub>1</sub>). White crystalline powder; very slight yeast-like or putty odor. Uses, containers, etc.  
**380J** Mallinckrodt Chem. Wks.

**Zirconium Hydride** . . . Metallic dark grey powder. Dissociates in vacuum above 500°C. Important uses: ceramic-metal seals; electronic getter; hydrogenation agent; etc. Find complete details in Bulletin No. 701.  
**380K** Metal Hydrides.

### Construction Materials

**Adhesives, Epoxy Resin** . . . Announces a new 16 p. Brochure containing the very latest technical data and price information on company's line of epoxy resin adhesives . . . for those difficult bonding problems.  
**380L** Armstrong Products Co.

**Alloys** . . . General information & technical data on vacuum-melted metals & alloys, as well as several commercial services now available in connection with such metals, included in new Technical Bulletin VM-100.  
**380M** Carbonyl Dept.

**Alloys, Hard-Facing**..... Protect against corrosion and abrasion make pump plungers, pistons, rings, bushings, any pump part last longer. Describes Sprayweld Process (Model C Spraywelder) in new Catalog. 326 Wall Colmonoy Corp.

**Coatings, Corrosion-Resistant**..... Illustrated 8 p. covers Alcoplate—a chemical nickel-plating process which produces a superior protective surface of uniform thickness on metallic objects of almost any shape. 381A American Locomotive Co.

**Fabrication, Metal**..... Manufactures metal products for many industrial uses... from complete carbon-black plants to steel conveyor boxes. Designs, engineers and fabricates to specific requirements. 309 Boardman Co.

**Fabrication, Process Equipment**..... New Bulletin outlines company's broad services: design & construction of process plants & process units; design &/or fabrication of special processing equipment; etc. 4 p. 381B Badger Mfg. Co.

**Fabrication, Process Equipment**..... If the vessel or component you need is large or small, irregular in shape or unusual in design, Acme's facilities guarantee exact adherence to specifications. Offers Folder. 91 Acme Welding Div.

**Jacketing, Aluminum**..... Light-weight, weatherproof aluminum jacketing arrives on the job in convenient rolls 4 feet wide and 100 feet long... easy for one man to handle. Provides valuable engineering data. 322 Chidders Mfg. Co.

**Platinum & Palladium, Electropolated**..... For each metal, Data Sheet describes physical properties, from atomic weight to reflectivity, & electrical properties, from resistivity to specific magnetic susceptibility. 381C Technic, Inc.

**Steels, Stainless**..... Company provides descriptive literature covering their valuable product line... complete information on Armco stainless steel sheets, strip, plates, bars & wire. "Armco Stainless Steels." 96a Armco Steel Corp.

**Steels, Stainless**..... Offers complete description of Carpenter Stainless No. 20 & No. 20-Cb in revised Catalog. Includes latest data on steel's corrosion resistance, applications, working characteristics. 20 n. 381D Carpenter Steel Co.

**Steels, Stainless**..... "Armco's ELC Stainless Steels," a new informative booklet, presents data on 2 extra-low carbon stainless steel grades that are fully satisfactory for service in welded equipment up to 800°F. 96b Armco Steel Corp.

## Electrical & Mechanical

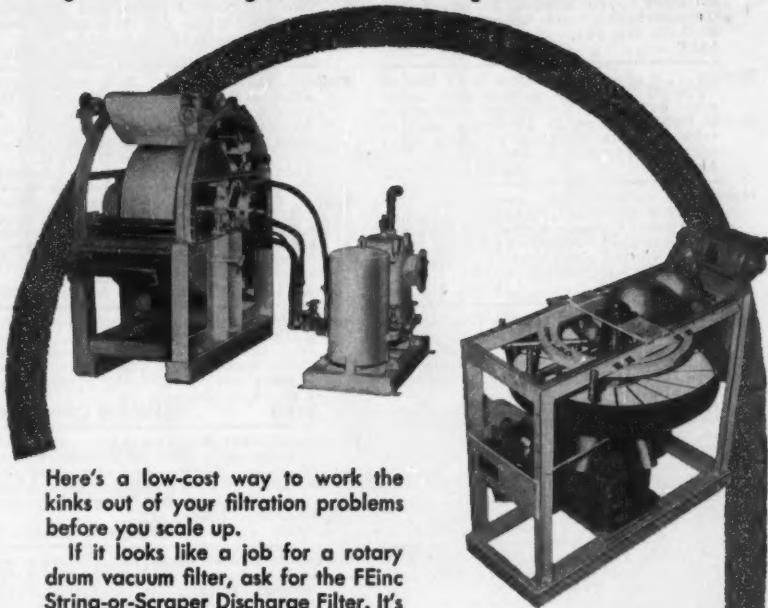
**Cables, Rubber-Insulated**..... 128 p. describes Okelite-Okoprene 0-5000 volt unshielded, rubber-insulated, neoprene-sheathed cable—construction, engineering data, installation & handling, etc. Bulletin OK-1085. 381E Okonite Co.

**Chain, Roller**..... Precision steel roller chain meets the 3 big requirements for lower drive & conveyor costs: (1) long life (2) low maintenance costs (3) high efficiency. Full details in 148 p. Data Book No. 2457. 89 Link-Belt Co.

**Drives, Speed**..... Describes company's new single wide-range belt variable speed drive. Shows how to design and select drives from 1 to 20 horsepower motors. Dimensions and lists prices fully covered. Bulletin 497. 381F T. H. Wood's Sons Co.

NOVEMBER 1954  
2  
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## PILOT PLANT FILTERS help reduce your development costs



Here's a low-cost way to work the kinks out of your filtration problems before you scale up.

If it looks like a job for a rotary drum vacuum filter, ask for the FEinc String-or-Scraper Discharge Filter. It's furnished with both the FEinc String Discharge and the FEinc Scraper Discharge mechanisms. You can try first one, then the other. It also has the FEinc submergence washing and compression dewatering mechanisms. These can be operated separately or disconnected if desired. This all-purpose pilot plant filter is available to you on a unique rental-purchase plan, requires no capital investment. Ask for details.

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## LITERATURE . . .

**Drives, Speed.** . . . New Cleveland Speed Variator is a simple compact drive that provides infinitely variable output speed over a 9:1 range from a constant speed power source. Data in illustrated Bulletin K-100.  
**382A** Cleveland Worm & Gear Co.

**Engines.** . . . Describes 225 to 675 hp Le Roi L3460 & L4000 engines. Cutaway views & studio photos show advanced design features—integral V-12 cylinder block design, counter balanced crankshaft, etc. Bulletin E-7.  
**382B** Westinghouse Air Brake Co.

**Isolators.** . . . New 8 p. brochure covers the features and uses of company's type 5200 shock and high vibration isolators . . . for application in marine, transportation and industrial fields. Bulletin No. 541.  
**382C** Barry Corp.

**Motors.** . . . As a companion to its line of Type M Uniblack motors with magnetic braking . . . company now offers a line of Type D Uniblack motors with dynamic braking. Provides complete information—Data 3810.  
**409** Master Elec. Co.

**Motors.** . . . Company's new Type GW Syncogear motor features many advantages. Cannot distort or misalign . . . because of cantilever design. New multi-colored descriptive reference gives full engineering details.  
**79** U. S. Elec. Motors.

**Motors.** . . . Offer continuous trouble-free performance. Wide range of types and sizes in complete line permits selection of a standard motor for almost any need. Provides full details in Bulletin No. MU-185.  
**86** Wagner Elec. Corp.

**Motors, Chemical.** . . . Announces development of a motor specially designed for chemical services. It is totally-enclosed & corrosion-protected, designed for dangerous & damaging atmospheres. Bulletin No. 1810.  
**382D** U. S. Elec. Motors.

**Motors, Wound-Rotor.** . . . The company has developed and is now manufacturing a new line of totally-enclosed non-ventilated and totally-enclosed fan-cooled wound-rotor motors. Complete details in Leaflet No. 51R8195.  
**382E** Allis-Chalmers Mfg. Co.

**Reducers, Speed.** . . . Company announces the availability of a new, 28 p. fully illustrated catalog containing revised rating tables of their herring-bone and spiral bevel-helical speed reducer line. Catalog 120.  
**382F** Brad Foote Gear Wks.

**Rings, Carbon Packing.** . . . Made of special carbon graphite material that automatically assures high resistance to wear, chemical inertness & excellent heat conductivity. Offers details plus sample carbon ring.  
**16** C. Lee Cook Mfg. Co.

**Turbines, Solid-Wheel.** . . . Feature reliable, trouble-free operation. Rugged construction and superior design result in savings by keeping maintenance costs down to a minimum. Full details in Bulletin No. S-116.  
**37** Terry Steam Turbine Co.

**Containers, Collapsible.** . . . Fully illustrated, 20 p. describes the new U. S. Seal-Bulk system of handling, shipping and storing . . . based on the 70 cu. ft. U. S. Seal-Bin collapsible container. Bulletin CP-70.  
**382G** U. S. Rubber Co.

**Conveyors, Belt, Sectional.** . . . Offers a complete set of belt conveyor components pre-engineered for customer assembly. Includes new carrier & return roll, heat & tall pulley assemblies, etc. Request Bulletin 1454.  
**382H** Stephens-Adamson Mfg. Co.

**Feeders.** . . . Describes new "fluid power" vibratory feeders with variable adjustment of the rate of flow. Explosion-proof—operate on air, oil or water pressure. Complete details in illustrated product literature.  
**382I** Syntex Co.

**Feeders.** . . . Valuable data on Model E in PVC—handles sulfuric, hydrochloric, & nitric acids of all grades. Covers features, physical characteristics, & specifications in company's fully illustrated Bulletin No. 541.  
**382J** Clarkson Co.

**Packaging.** . . . Offers 32 p. fully-illustrated booklet entitled, "How To Pack It." Describes a unique selection of twelve different styles and more than seventy types of corrugated boxes for a variety of products.  
**382K** Hinde & Dauch.

**Pulleys, Magnetic.** . . . Now offers a powerful new electro-magnetic pulley that provides exceptional tramp iron removal throughout the entire load mass. Features advantages of 2-coil design. Data in Bulletin 303-C.  
**275** Stearns Magnetic.

**Scales, Automatic Filling.** . . . Model 600G automatically holds, fills, check-weighs, releases bags of powdered materials within close tolerances. Offers complete description, performance data, specifications, etc.  
**382L** Thayer Scale & Engrg. Corp.

**Scales, Platform.** . . . Describes new electric platform weighing scale . . . a modern platform scale adaptable for either batch weighing or continuous process control utilizing strain gauge load cells. Catalog 20.  
**382M** Weighing Components.

**Tractor-Shovel Attachments.** . . . "Useful Attachments for Payloader Tractor Shovels" illustrates and describes rotary "V" and trip-blade snow plows, hydraulic backhoe, lumberlog rack, backfiller blade, etc.  
**382N** Frank G. Hough Co.

**Transport Bodies, Bulk.** . . . Offers a new 6 p. reference describing the large-volume Bulkmobile transport body. Designed for the big jobs, new units save up to 75% on handling time. Full details in Bulletin A-399.  
**382O** Baughman Mfg. Co.

**Vibrating Equipment.** . . . Presents 232 p. fully illustrated catalog—a complete and concise reference book covering electric and mechanical vibrators, separators. Request Catalog No. 870.  
**61a** Jeffrey Mfg. Co.

**Burners, Oil.** . . . Makes available an illustrated bulletin describing company line of high velocity oil burners. Includes operating principles, applications, dimensions, and output data. Request Bulletin No. 107.  
**382P** Thermal Research & Engrg.

**Chillers, Package.** . . . Introduces a new line of package chillers for chilled water air conditioning systems, drinking water or beverage cooling applications & industrial water cooling uses. Descriptive Bulletin.  
**382Q** Heat-X-Changer Co.

**Exchangers, Scrapped Surface.** . . . Closed pressure-type systems which permit use of flammable, volatile and expensive solvents with greatest safety and no danger of solvent loss. Details in Bulletin PE-1.  
**85** Henry Vogt Mach. Co.

**Generating Units, Steam.** . . . Presents an illustrated Bulletin describing the company's steam generating and fuel burning equipment . . . for public utility and industrial power and heating plants. Request your copy.  
**382R** Riley Stoker Corp.

**Heat Exchangers.** . . . Illustrated, 8 p. covers line of shell and tube heat exchangers for the chemical and petroleum industries. Custom built to meet your most exacting processing requirements. Catalog No. HT-40.  
**382S** National Radiator Co.

**Heat Transfer & Crystallization.** . . . Offers descriptive literature . . . a 52 p. book giving practical presentation of the fundamentals of modern evaporation & crystallization methods & equipment. Bulletin E-106.  
**921** Swenson Evaporator Co.

**Heaters, Dielectric.** . . . New reference describes operating advantages. Tells how heaters can help cut costs in heating, drying, baking or curing of nonconduction materials. Request illustrated Bulletin No. 15B6431B.  
**382T** Allis-Chalmers Mfg. Co.

**Heaters, Graduation.** . . . Selas Graduation Zone Control offers new possibilities in every chemical plant where heat processing is a precise operation. Provides complete information in a new 16 p. booklet.  
**72** Selas Corp. of America.

**Heating Elements, Electrical.** . . . Flexible electrical heating elements for general industrial use. Perform continuously at 450°F.; operate under high pneumatic pressure; light weight—tough; etc. Illustrated, 4 p.  
**382U** Electro-Flex Heat.

**Heating Elements, Electrical.** . . . Releases a new, fact-filled Catalog on Heatflex electrical heating elements containing descriptive material, applications, specifications & engineering information. 8 p.  
**382V** Continental Elec. Equipment.

**Pipe Coils.** . . . Company makes available a completely illustrated reference describing their square-finned pipe coils. Includes information on features & advantages, specifications, dimensions, etc. Bulletin 158.  
**382W** Frick Co.

**Platecoils.** . . . Designed for tank heating and cooling problems due to inefficient pipe coils. These cost-saving Platecoils heat or cool 50% faster and take 50% less space in the tank. Bulletin No. P61.  
**50** Tranter Mfg.

**Shell-Ice Makers.** . . . Shell-ice can be made in pieces as small as desired. Ice is hard & solid, giving greatest refrigerating effect in use. Covers operating principle, construction, advantages, etc. Bulletin No. 54.  
**382X** Frick Co.

**Thermo-Panels.** . . . Cost less and perform better—an improvement on pipe coils. You save space & heat or cool more efficiently. For use in heating & cooling of liquids, slurries, soaps, waxes, etc. Offers Bulletin B404.  
**Thermo-Panel Div.**

**Traps, Steam.** . . . Company introduces new  $\frac{1}{2}$ " impulse steam trap . . . especially designed with low capacity to handle light condensate loads. Won't freeze or air bind on steam tracer line service. Detailed Leaflet.  
**382Y** Varnall-Waring Co.

**Traps, Steam & Air.** . . . Detailed information on steam and air traps—high capacity traps designed to handle pressures to 600 psig. Feature design simplicity and lowest maintenance and repair record. Bulletin 5415.  
**382Z** C. E. Squires Co.

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on any of these items? Just  
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## Handling & Packaging

**Containers, Collapsible.** . . . Fully illustrated, 20 p. describes the new U. S. Seal-Bulk system of handling, shipping and storing . . . based on the 70 cu. ft. U. S. Seal-Bin collapsible container. Bulletin CP-70.  
**382G** U. S. Rubber Co.

**Conveyors, Belt, Sectional.** . . . Offers a complete set of belt conveyor components pre-engineered for customer assembly. Includes new carrier & return roll, heat & tall pulley assemblies, etc. Request Bulletin 1454.  
**382H** Stephens-Adamson Mfg. Co.

## Instruments & Controls

**Amplifiers, D-C Indicating**.....Describes new design approach, exceedingly stable performance and unique principle of operation. Also includes a photographic illustration along with typical applications. Bulletin 1A. 383A Doelcam Corp.

**Analyzers, Gas, Combustible**.....Covers complete line of combustible gas analyzers and alarms. Contains details of how these instruments work and describes the components. Fully illustrated 20 p. Brochure No. 0703-3. 383B Mine Safety Appliance Co.

**Analyzers, Oxygen**.....Presents valuable information concerning the continuous specific oxygen analyzer...designed for low range measurement of oxygen in gaseous streams. Find complete data in Bulletin 11-40. 383C Davis Emergency Equipment.

**Control Systems, Combustion**.....Provide complete automatic starting and operating flame failure protection for commercial light oil, gas, and combination light oil/gas burners. Illustrated 16 p. Bulletin CF-30. 383D Electronics Corp. of Amer.

**Controllers, Indicating**.....New, completely self-contained, direct deflection, indicating controller is adaptable to a multitude of process applications. Details in Bulletin F-6314 & Educational Bulletin 9. 383E Wheelco Instruments Div.

**Controllers, Indicating**.....Offers data on new Series 560 controller...with revolutionary thermistor principle of operation for kilns, ovens, furnaces, extruding, air heaters, etc. Features & specifications. 383F Fenwal, Inc.

**Controllers, Limit**.....Describes a new limit controller...providing economical insurance against human or instrument failures which may permit overshooting of critical temperatures. Bulletin No. F-6313. 383G Wheelco Instruments Div.

**Controllers, Program**.....Assure completely automatic process control of any time-temperature cycle with On, Proportioning, High Limit or Stepless control action plus Secondary control action. Bulletin JG-1. 383H West Instrument Corp.

**Controllers, Time Cycle**.....Versatile, automatic time-cycle instruments designed to provide a higher degree of flexibility, simplicity and ease of adjustment. Complete description in Illustrated Bulletin 98154. 383I Taylor Instrument Cos.

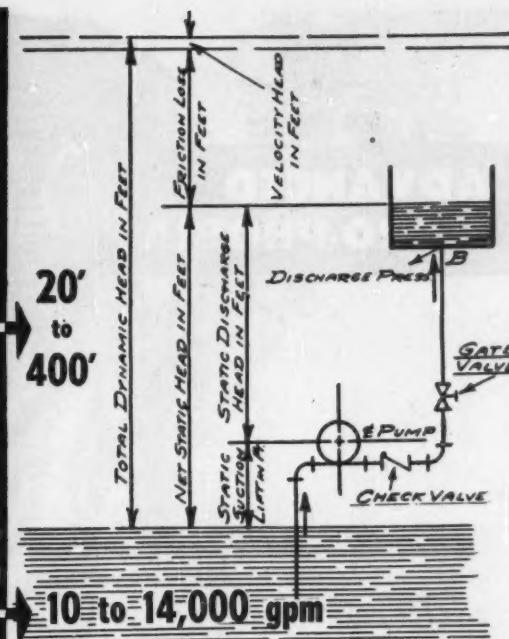
**Controls, Level**.....Equipment designed to provide link between capacitive-type electronic level-sensing equipment & corresponding actuation of pneumatic control valves described in new leaflet Form CP2. 383J Thermo Instruments Co.

**Controls, Pressure-Drop**.....Will perform with high-efficiency on your column...whether it's packed, bubble cap, or sleeve-plate type...on continuous or batch runs. Details in Engineering Data Sheet 282-14. 60 Foxboro Co.

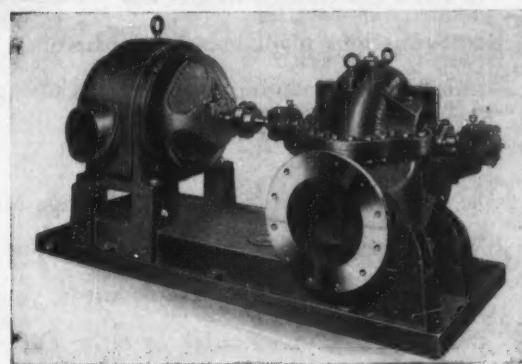
**Controls, Supervisory**.....Describes accurate digital supervisory control expressly designed for remote measurement & such control functions as remote shaft positioning, on-off switching, etc. Bulletin ES-1. 383K Bendix Aviation Corp.

**Controls, Temperature**.....A new and inexpensive non-bled pneumatic temperature control is now available for operation of such devices as diaphragm valves, damper motors, etc. Full details in Bulletin 308. 383L Powers Regulator Co.

**Controls, Temperature**.....Covers the Model D-1S...primarily used for controlling temperatures up to 1800°F., where a wide and easily adjustable range is required. Complete information contained in Bulletin 104. 384A Burling Instrument Co.



**THERE'S A  
"BUFFALO"  
DOUBLE  
SUCTION  
PUMP  
FOR  
HIGHEST  
EFFICIENCY**



"Buffalo" Type "SL" Double Suction Pump. Write for Bulletin 955-P for all details.

If you wish to move large volumes of clear water at heads up to 400', this Type SL Double Suction Pump is your ideal choice. It offers you:

- (1) The finest construction, embodying the best accepted pump engineering features—the famous "Q" Factor\*.
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In addition to these pumps, "Buffalo" builds single suction, single stage and multistage centrifugal pumps for every type of service. We shall be happy to supply you with details on any of these lines—all backed by 78 years of quality pump manufacturing.



\*The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.

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BUFFALO, N.Y.

Subsidiary of Buffalo Forge Company

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A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

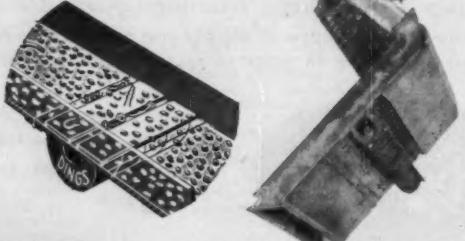
## ADVANCED FERRO-PHOBIA

... Fer'ro-phobia, n. Fear of iron. It's enough to kill any cost-conscious plant manager—fear of tramp iron damaging equipment, causing shutdowns, ruining product purity.

No couch can cure it, but a Dings Magnet can. When ferro-phobia symptoms—unhappy people moaning about lost production—show up in your plant, phone your representative or write Dings. They'll prepare an effective magnetic Rx, backed by 50 years of experience, that will end the plague in a hurry.

We Wiped Out the Plague in Texas—With this "super" 3-stage magnetic hump built for one of the nation's biggest plastic manufacturers. It separates iron contaminated polyethylene pellets from iron-free pellets.

Powerful, non-electric Dings Perma-Plate magnets stop iron in the hump, chutes or ducts. Magnetic strength guaranteed forever.



**DINGS MAGNETIC  
SEPARATOR COMPANY**  
4730 West Electric Avenue  
Milwaukee 64, Wisconsin

PP154

### LITERATURE . . .

**Counters, Control**.....New 20 p. Booklet contains detailed descriptions of equipment & techniques for controlling industrial equipment by means of pre-determined electronic counters. Applications explained & illustrated. 384B Potter Instrument Co.

**Counters, Flow**.....Introduces the first commercially practicable, completely sealed automatic flow counter. This new unit accommodates up to twenty-five samples. For complete information request Bulletin No. 57. 384C Tracerlab, Inc.

**Detectors, Leak**.....New ultra-sensitive leak detector capable of detecting one part of helium in two-million parts of air. Most sensitive instrument for production line testing operations. Bulletin No. 1801C. 384D Consolidated Engrg. Corp.

**Gages, Liquid Level**.....Covers 3 standard types of convex scale and flat scale Truscale remote reading gages, showing how gages bring liquid level down to where it can easily be seen. 8 p. Illustrated Catalog 246. 384E Jerguson Gage & Valve Co.

**Generators, Ultrasonic**.....For industrial processing & laboratory research. Offer valuable features: wide frequency range 10-1200 Kcs./sec.; continuous tuning; constant high power throughout frequency range, etc. 4 p. 384F Rich-Roth Labs.

**Indicators, Gas**.....Offers the gas industry the M.S.A. Gascope—a simple and dependable instrument for the detection and "pin-pointing" of gas leaks in distribution systems. Data in illustrated Bulletin 0804-1. 384G Mine Safety Appliances Co.

**Indicators, pH**.....Furnishes informative literature describing company's new panel-mounted indicator for continuous measurement of pH or redox in manufacturing processes. Illustrated Data Sheet No. ND42-961(1). 384H Leeds & Northrup Co.

**Instruments, Data Processing**.....12 p. catalog furnishes information on the company's full line of data-processing equipment, ranging from miniature transducers to entire instrumentation systems. Bulletin CEC-1301. 384I Consolidated Engrg. Corp.

**Measurement, Dewpoint**.....Describes dewpoint recorder including details about new multiple source type which automatically records dewpoints from 6 different sources in rapid succession. Data Sheet No. 10.5-1a. 384J Minneapolis-Honeywell.

**Measurement, Oxygen**.....Describes the application & operation of the A. O. Beckman Model F-3 oxygen analyzer & Brown Electronik recorder for measurement of oxygen in industrial processes. Data Sheet 10.15-11. 384K Minneapolis-Honeywell.

**Meters**.....Describes the Gyro Mass Meter...for precise flow measurement. Answers continuous flow batching, inventory, cost-accounting and process control problems. Complete details in illustrated Bulletin No. 640. 384L Control Engrg. Corp.

**Meters & Regulators**.....20 p. fully illustrated booklet describes Rockwell products...for sewage disposal plants. Includes data on sewage gas meters, sewage gas regulators, water meters, etc. Bulletin C-5200. 384M Rockwell Mfg. Co.

**Microscopy, Fluorescence**.....Fluorescence microscopy with fluorochromes is fully described in 30 p. booklet. Reference contains valuable information concerning the application, including formulas and tables. 384N William J. Hacker & Co.

**Monitors, Liquid Level**.....A new & different high (to within 1/16") accuracy liquid level monitor for continuous level indication, recording & control in storage & processing tanks. Completely illustrated. 386A Techniflex Corp.

**"she might have been my kid..."**



**T**here was no time to stop, see? She comes running out from behind this parked car right under my wheels. Her hair is in pig-tails, and with the sun shining on it, she might have been *my kid*. We got her to the hospital. It took 3 pints of blood to bring her around. All I have to do is remember the sound of those screaming tires—and I know

why *I'm giving blood.*"

Yes, all kinds of people give blood—truck drivers, office workers, salesmen. And—for all kinds of reasons. But whatever *your reason*, this you can be sure of: Whether your blood goes to a local hospital, a combat area or for Civil Defense needs—this priceless, painless gift will some day save an American life!

#### **Business Executives!**

#### **✓ Check These Questions!**

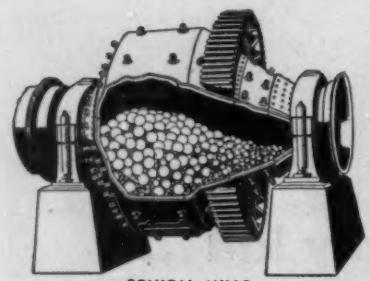
If you can answer "yes" to most of them, you—and your company—are doing a needed job for the National Blood Program.

- Have you given your employees time off to make blood donations?
- Has your company given any recognition to donors?
- Do you have a Blood Donor Honor Roll in your company?
- Have you arranged to have a Bloodmobile make regular visits?
- Has your management endorsed the local Blood Donor Program?
- Have you informed your employees of your company's plan of co-operation?
- Was this information given through Plant Bulletin or House Magazine?
- Have you conducted a Donor Pledge Campaign in your company?
- Have you set up a list of volunteers so that efficient plans can be made for scheduling donors?

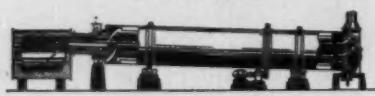
Remember, as long as a single pint of blood may mean the difference between life and death for any American . . . the need for blood is *urgent!*

**Give Blood Now**  
CALL YOUR RED CROSS TODAY!  
NATIONAL BLOOD PROGRAM





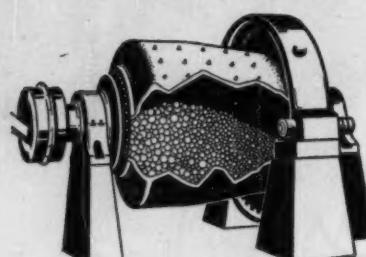
CONICAL MILLS



SINGLE-SHELL ROTARY DRYERS



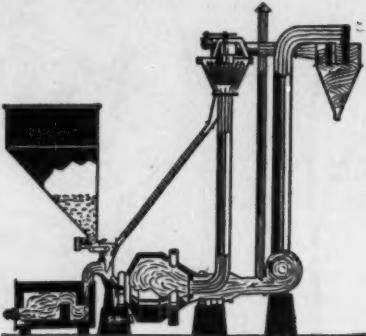
DOUBLE-SHELL ROTARY DRYERS



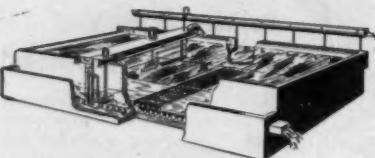
TRICONE MILLS



THICKENERS—CLARIFIERS



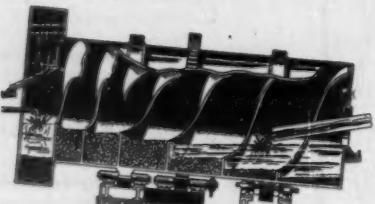
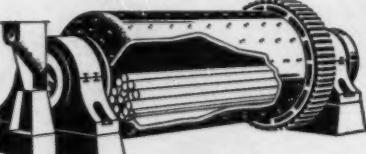
AIR CLASSIFYING SYSTEMS



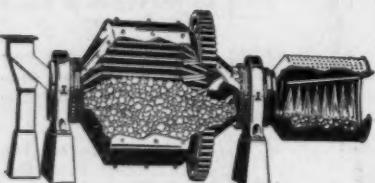
AUTOMATIC BACKWASH SAND FILTERS



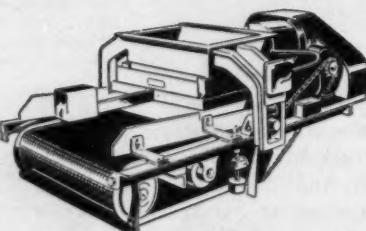
ROTARY AND SHAFT KILNS

COUNTER-CURRENT CLASSIFIERS  
HEAVY-MEDIA SEPARATORS

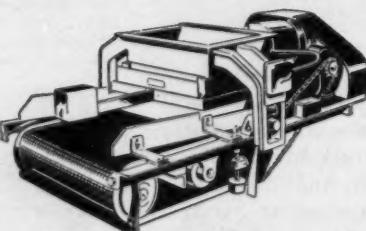
ROD MILLS



CONICAL SCRUBBERS



ROTARY COOLERS



CONSTANT-WEIGHT FEEDERS

Write for general catalog 100-A-11 which describes the entire Hardinge line.

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COMPANY, INCORPORATED

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## LITERATURE . . .

### Building up files?

Then you can cash in right now on our new, comprehensive Guide to Technical Literature in this issue. There you'll find a checklist of the current and latest literature on any topic in your field — easy to get, too.

**Ozonators, Laboratory** . . . . Are designed as precision laboratory instruments capable of constant and reproducible operation, positively safe to use. Find complete details on the Model T-23 in descriptive Folder.

81a Welsbach Corp.

**Recorder-Controllers** . . . . Describes the Honeywell quick-connect Tel-O-Set miniature recorder and controller. Includes information on features, operation, specifications, etc. 12 p. illustrated Bulletin No. 7201.

386B Minneapolis-Honeywell.

**Recording - Controllers** . . . . Instruments featured in new bulletin, which describes potentiometer pyrometer & resistance thermometer controllers with either 2-position or pulse-proportional control action. Bulletin No. 62.

386C Thermo Elec. Co.

**Regulators, Temperature** . . . . Economical temperature regulators offer many advantages: accuracy of control; dependability; minimum installation & maintenance cost; etc. Complete details in Bulletin No. T500.

63 Spence Engrg. Co.

**Sampling Systems** . . . . Announces a newly developed sampling system for continuous trouble-free sampling and oxygen measurement of combustion processes. Describes operation and advantages in Bulletin No. 703.

386D Arnold O. Beckman.

**Servo Systems** . . . . New 4 p. booklet pictures & describes a recently-developed servomechanism system. Includes information on construction features & lists the operating characteristics. Technical Reference No. 54B.

386E Richardson Scale Co.

**Testers, Magnetic Thickness** . . . . Complete description of the Pocket Handi-Gage . . . magnetic thickness tester for electrodeposited, hot dipped, or painted coatings on steel. Features & directions in Bulletin 159.

386F Gardner Lab.

**Thermocouple Elements** . . . . New Bulletin covers line of Serv-Rite thermocouple elements & bare thermocouple wire. Includes general application data for various types of elements & the different metals. Illustrated.

386G Claud S. Gordon Co.

**Transducers** . . . . Company announces the availability of literature describing the Vernistat . . . a new type of transducer. Includes data on advantages, construction, specifications, etc. In fully illustrated, 6 p.

386H Perkin-Elmer Corp.

**Weighing Systems** . . . . For measuring load, fluid pressure, or torque more accurately and economically. Offers Booklet No. 4106 covering tank weighing and also Booklet No. 4105 with data on crane scales.

80 Baldwin-Lima-Hamilton.

## Pipe, Fittings, Valves

**Couplings, Fluid** . . . . Illustrated, 14 p. offers full installation and performance data on company line. Graphically shows the ease of applying fluid couplings on any type industrial equipment. Bulletin 144-D.

388A Twin Disc Clutch Co.

**Bookkeepers...  
Bakers...  
and Busy  
Dressmakers...**



## *Americans Are Rolling Up Their Sleeves!*

**YES, ALL KINDS OF PEOPLE  
ARE GIVING BLOOD SO THAT  
OUR WOUNDED MAY LIVE!**

- Today, the blood of a Boston bookkeeper may be flowing through the veins of a wounded kid from a Kansas farm . . . the blood of a pretty Southern housewife may have saved the life of a grizzled leatherneck. For, blood is blood, a God-given miracle for which there is no substitute . . . and when a man's life hangs in the balance and blood is needed, there is nothing else to take its place!

Right now the need for blood is urgent. In hospitals—at home and overseas—

many men require four and six transfusions during delicate operations. And the blood *must* be there—when it's needed. So give the most precious gift of all—*your blood!*

Be assured that giving blood is neither difficult nor distressing. And what a thrill there is in knowing that you've performed a really unselfish act! So call your local American Red Cross today and make an appointment. And tell your friends and neighbors about your experience. Let them share the wonderful feeling Americans get when they roll up their sleeves—and give blood.

*But—*

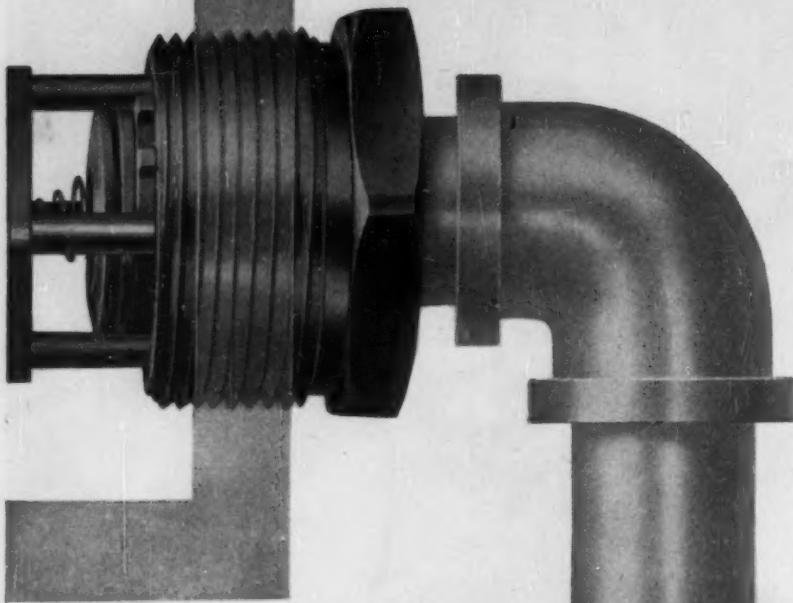
**WHAT HAPPENED  
TO THAT PINT OF  
BLOOD YOU WERE  
GOING TO GIVE?**



*"Call Your American Red Cross Today!"*



# HERE is the ideal CHECK VALVE for tanks and other vessels



When used with tanks (as shown here), dry cans, retorts and pressure vessels of all kinds, the DURABLA Check Valve Unit is the lowest cost, high-quality valve you can buy.

**LOW COST**—The cost is low because all you buy are the working parts. The vessel wall acts as the valve body.

**HIGH QUALITY**—Made of stainless steel (or a combination of stainless steel and Ni-resist), these valves will handle practically any liquid, gas or air—at all temperatures and pressures. They will operate in any position.

DURABLA Check Valves are available in seven standard line sizes, from  $\frac{3}{8}$ " to 2". Ask your distributor for complete information or write us direct for bulletin P-1. DM-15

# DURABLA

DURABLA MANUFACTURING COMPANY

114 Liberty Street, New York 6, N. Y.

## LITERATURE . . .

**Couplings, Pipe** . . . . Information on the All-Flex ball bearing swivel pipe coupling. Made with quality materials... of sound engineering design... machined to close tolerances... etc. Catalog No. 234L. **388B** H & N Mfg. Corp.

**Fittings** . . . . Offers Klinger Master Catalog describing the complete range of products . . . compressed asbestos sheet packings for all purposes, valves, cocks, level gages, synthetic and silicon cone rubbers. **288a** Klinger Corp. of America.

**Tubes, Steel** . . . . "One source" supply offers seamless and welded stainless and seamless carbon and alloy steel tubes in complete range of sizes and analyses. Details of company's line in Globe General Catalog. **269** Globe Steel Tubes Co.

**Tubing & Line Pipe, Fibercast** . . . . A product of thermosetting resins reinforced with glass fibers and cured by heat. Covers advantages, general handling instructions, installation instructions, etc. Illustrated. **388C** Fibercast Corp.

**Valves, Control** . . . . Offers complete information on the Ultravalve. Incorporates all the features of special Hammel-Dahl valves used on the most dangerous applications. Request illustrated Bulletin No. 103-B. **169** Hammel-Dahl Co.

**Valves, Diaphragm** . . . . Greatly reduce replacement and maintenance expenses, especially in lines where corrosion, abrasion, contamination, clogging and leakage can be costly factors. Catalog presents full details. **8** Grinnell Co.

**Valves, Discharge** . . . . Data on completely new stainless steel discharge valves for use on all types of truck tanks. Tells how you can save many hours by speeding up unloading of bulk liquids. Fully illustrated. **6 p.** **388D** Chem-Valve Corp.

**Valves & Fittings** . . . . Descriptive reference, "Valves and Fittings for Ammonia and Freon-12," provides sizes, symbol numbers, dimensions and weights of valves, fittings and accessories. Request Catalog "O". **388E** Fricke Co.

**Valves, Fog & Deluge** . . . . Information & specifications on new line of fog & deluge valves. Includes data on the types, operation, ratings, materials of construction, installation, etc. Illustrated Forms 115, 116, 117. **388F** McRae Corp.

**Valves, Gate** . . . . Offers data on sturdy, small forged steel gate valves. Superhardened gate and seats assure tight closure, smooth operation and low maintenance. Complete information in Catalog No. 10. **276** Chapman Valve Mfg. Co.

**Valves, Nickel Iron** . . . . Designed primarily for the chemical process industries. Constructed of nickel iron, these valves are recommended for low-cost control of moderately corrosive fluids. Bulletin No. 118. **76** Jenkins Bros.

**Valves, Plug** . . . . Equipped with special-coated plug . . . for superior performance. Special coating assures tight seal & is highly resistant to abrasion & corrosion. Complete information in Valve Catalog. **76a** Wedgeplug Valve Co.

**Valves, Porcelain** . . . . Solid, unfilled teflon, in a wedge-ring arrangement, provides a packing for valves which features long serviceability . . . low maintenance requirements. Bulletin offers a complete description. **38** Lapp Insulator Co.

**Valves, Relief, Multiport** . . . . For automatic regulated relief of overpressure steam, air, or gas to atmosphere. Provide safe, continuous operation on toughest jobs. Sizes 4" to 48". Details in Publication No. 5200. **389A** Cochrane Corp.

**Valves, Safety**.....New Frick Type AF safety valves tested for capacity & approved for use with various refrigerants by the National Board of Boiler & Pressure Vessel Inspectors. Details in Bulletin 194-A.

389B Frick Co.

**Valves, Safety Shut-off**.....Combination gas shutoff valves provide valuable features: mount in any position; positive shutoff; foolproof design; vibration-proof; explosion-proof; rapid action; etc. Form 200.

389C Valco, Inc.

## Process Equipment

**Centrifugals, Continuous**.....Illustrated Bulletin describes application of continuous centrifugal filters, listing 75 materials on which they are successfully used, with specific examples of performance.

389D Bird Mach. Co.

**Centrifugals, Suspended**.....Presents detailed information upon request covering company line of Suspended Centrifugals with Gyro-Balanced suspension head, & optional unloading & time control equipment.

389E Bird Mach. Co.

**Centrifuges**.....High speed dehydrating centrifuge offers precise external control of variations in flow rate, crystal size & slurry concentration & permits intermediate treatment of crystals. Bulletin No. 1257.

119 Sharples Corp.

**Centrifuges**.....Descriptive information on the De Laval Gyro-Tester...for laboratory and pilot plant. Combines high speed test tube centrifuge and continuous, constant efficiency centrifuge. Illustrated.

389F De Laval Separator Co.

**Classifiers, Continuous Centrifugal**.....Company makes available descriptive literature on continuous centrifugal classifiers—what they do, how they work, with examples and pictures of successful applications.

389G Bird Mach. Co.

**Cleaners, Air**.....Illustrated, 8 p. covers line of electronic air cleaners. Includes principle of operation, methods of testing air filter efficiency, general construction features, etc. AIA File No. 30-D-3.

389H Electro-air Cleaner Co.

**Cyclones**.....12 p. Catalog illustrates 4 basic model cyclones and completely describes new features of moulded pure gum replaceable lining and integral 2-stage cylindrical design. Find information in Bulletin No. 121.

389I Equipment Engrs.

**Deminerlizers**.....Available in two-bed, three-bed, four-bed and mixed bed units, of manual and automatic designs, and for any capacity. Complete information in Publication 5800. Handbook on Deminerlization.

389J Cochrane Corp.

**Dryers**.....Company's line of vacuum rotary dryers provide low temperature drying with agitation...and recovery of solvents. Built in a wide range of sizes. Find complete data in Buflovak Catalog No. 341.

255 Buflovak Equipment Div.

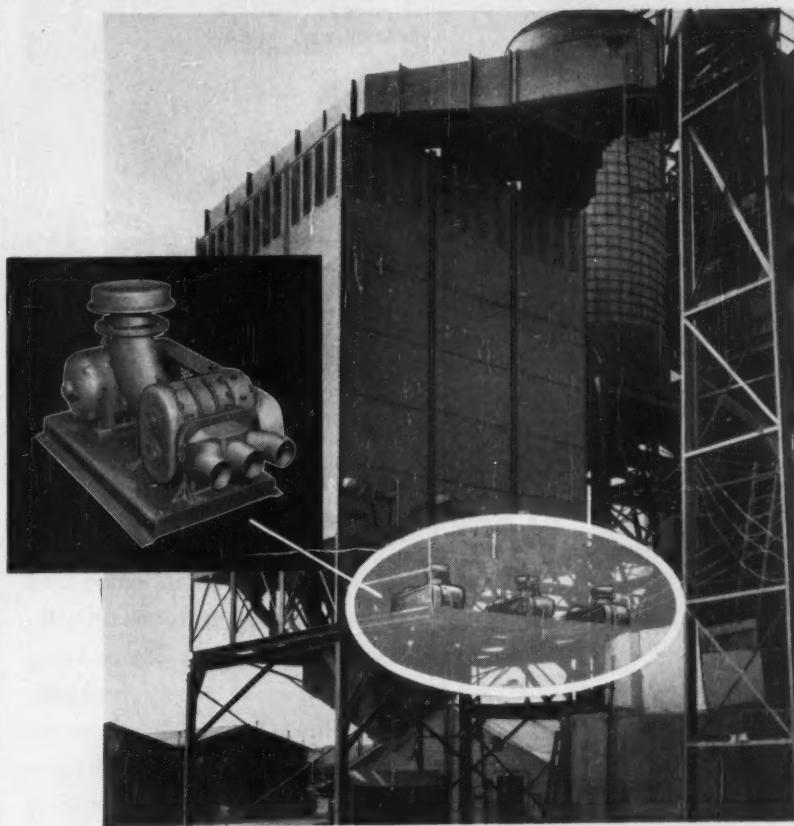
**Dryers**.....Relatively high capacity compact rotating drum dryer of advanced design now produced for drying or heating granular crystalline materials in steel & by-product processing industries. Bulletin 181.

389A Roberts & Schaefer Co.

**Dryers**.....Deliver top production, exacting performance, greater profits. Designed and constructed for hundreds of products and installed in countries throughout the world. 12 p. Illustrated Bulletin.

94 Standard Steel Co.

# MIEHLE-DEXTER BLOWERS eliminate filter clogging, caking, shaking and disposal



## HOW PRECIPITATOR COSTS ARE REDUCED FOR GRAVEL AND ASPHALT PLANT

The nation's growing battle against air pollution focuses attention on the need for modern precipitator equipment. Manufacturers like Western Precipitation Corp. have learned how Miehle-Dexter Positive Displacement Blowers help assure smoke and dust abatement.

For instance, on this Detroit, Michigan installation, located at a gravel and asphalt plant, three belt-driven M-D Blowers provide pressure air for cleaning the filters. Old-fashioned methods of shaking filters clean are eliminated. What's more, there is no clogging or caking of filters...no need for washing them. Costs of operating and maintaining this equipment are reduced.

Miehle-Dexter Blowers save weight and space, require little or no maintenance. Capacities available: 50-4000 c.f.m. or multiples thereof with single-drive arrangements. Discharge pressure: to 14 p.s.i.g. Vacuum: to 15" h.g.

If you have a product or process requiring dependable movement of air or gas, call on Miehle-Dexter. Our engineers will work with you...demonstrate how Miehle-Dexter Blowers can simplify operation and reduce costs for you. Write for new Bulletin No. 255.

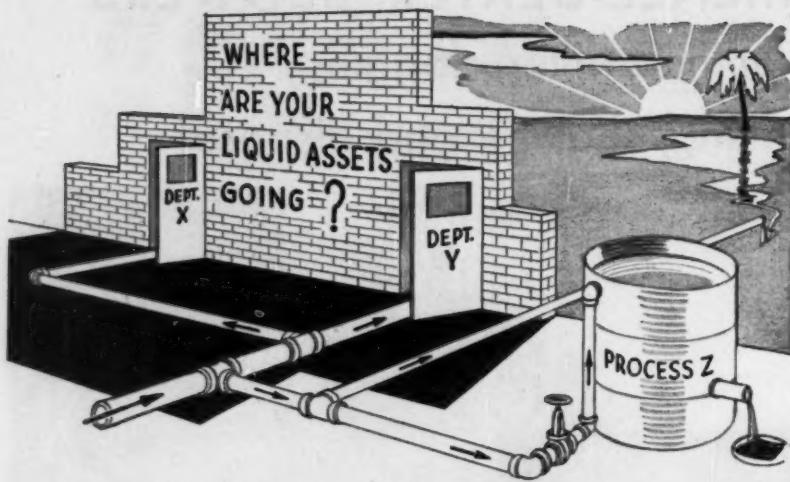


## MIEHLE-DEXTER SUPERCHARGER

Division of the Dexter Folder Company

101 Fourth Street

Racine, Wisconsin



# WATER costs MONEY

## Here's a Simple Way to Reduce the Cost

The costs of pumping, purifying, softening and distributing water are something to reckon with. Whether you buy from your local utility or pump your own, your plant water supply probably costs more than it should. Hoses left running, cooling water running down the drain instead of recirculating, neglected leaks, etc., quickly add up to large losses. What's worse, they deplete scarce water resources. Even the cost of sewage disposal depends upon water used.

Best way to cut these costs? Put Neptune water meters at every key point. Get water out of overhead and charge it fairly and squarely against each department or process. What stronger incentive to fix faulty equipment and stop careless habits?

Other Neptune meters also available for handling more than 150 industrial liquids. Ask today for full details . . . or a complete plant survey at no obligation.

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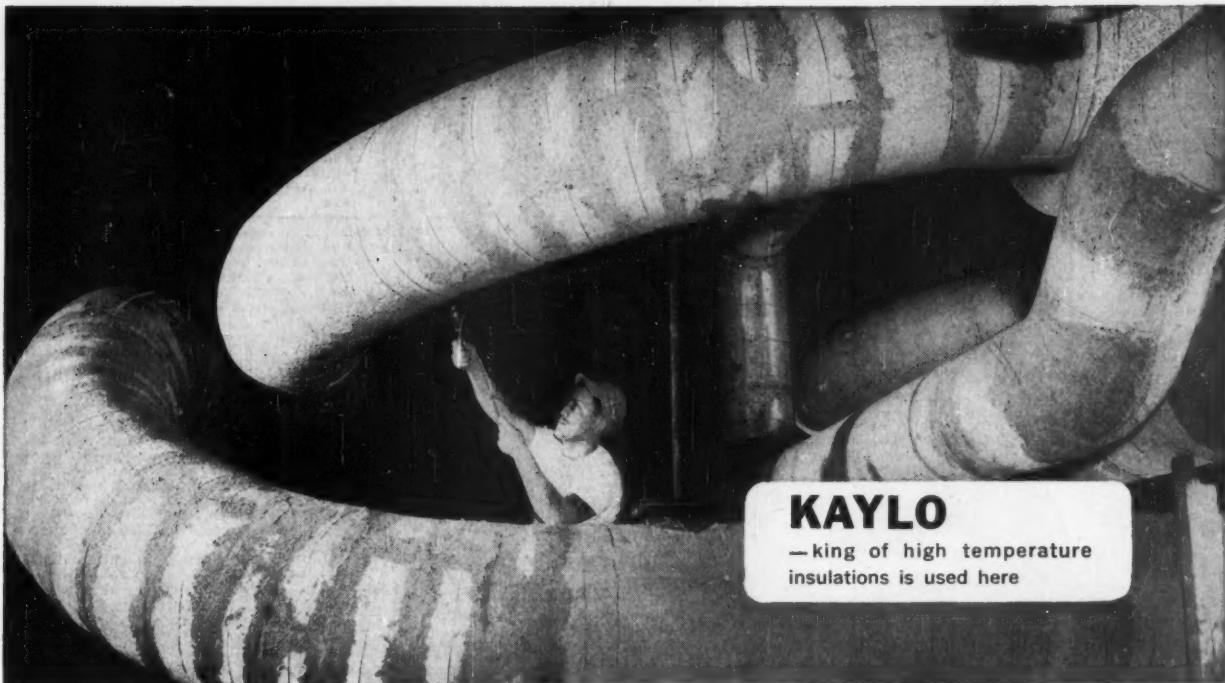
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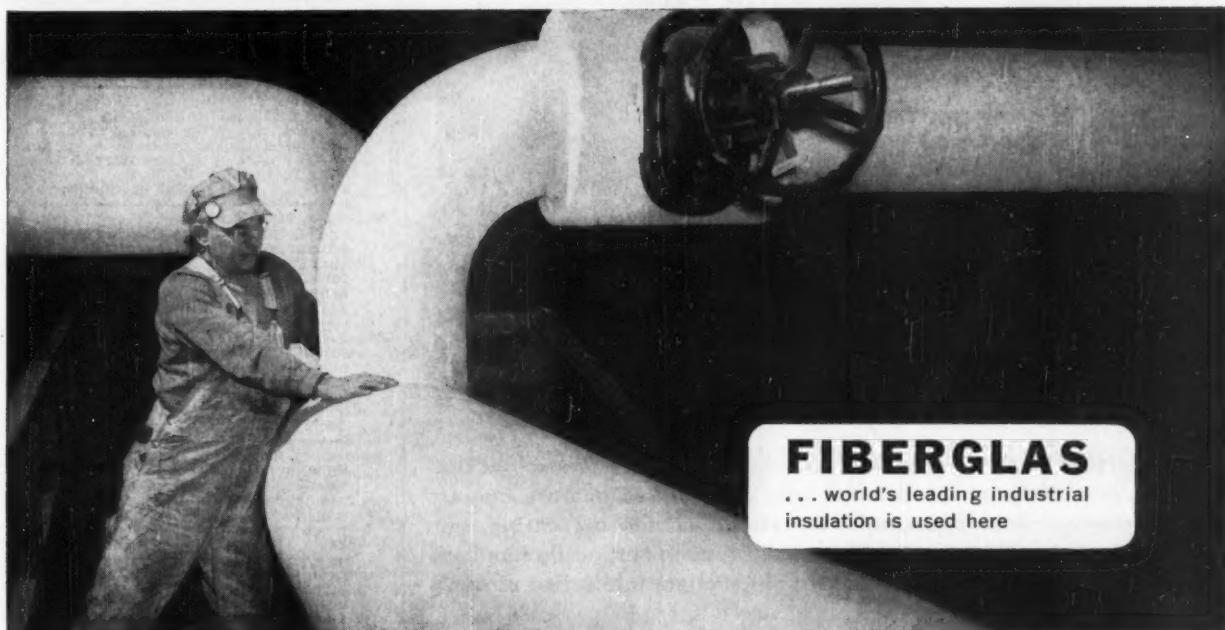
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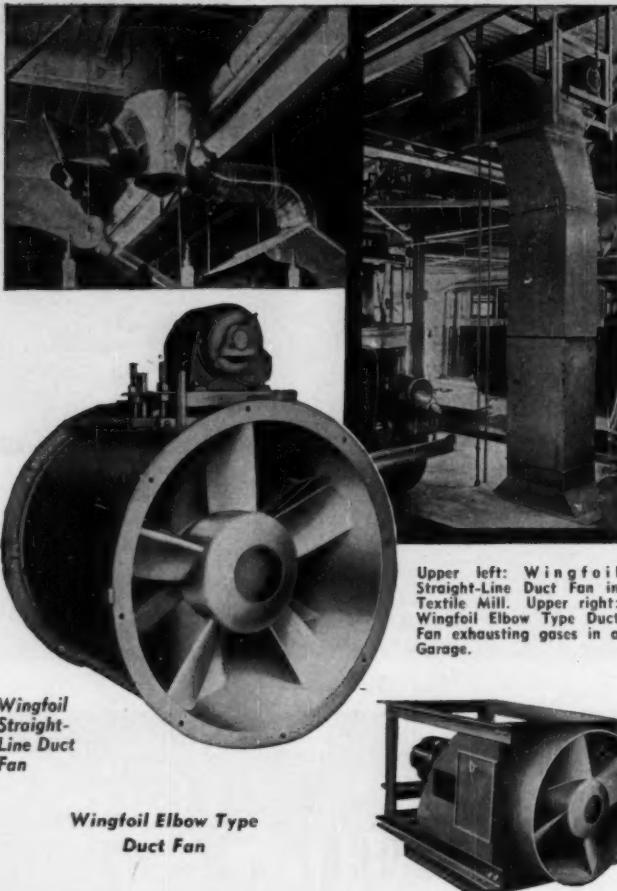
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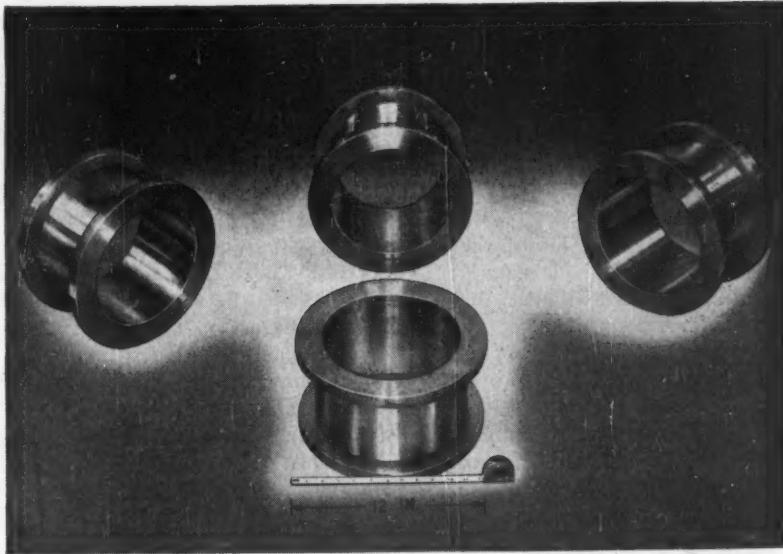
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# Index to Advertisers

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|  |         |   |       |  |          |
|--|---------|---|-------|--|----------|
| Acme Welding Div. of the United Tool & Die Co.....                                   | 91      | Bird Machine Co.....  | 6, 11 | Control Engineering Corp.....                                | 245      |
| Admiral Tool & Mfg. Co., Inc. ....   | LT404   | Blaw-Knox Co. (Buflakov Div.) ..  | 255   | Cook Mfg. Co., C. Lee.....                                   | 16       |
| Aerofin Corp. ....   | 323     | Blickman, Inc., S. ....   | 394   | Cooper Alloy Corp.....                                       | 7        |
| Air Preheater Corp. ....   | 87      | Boardman Co., The .....   | 309   | Cooper-Bessemer Corp., The... .                              | 163      |
| Air Reduction Co., Pure Carbonic Co. Div.....  | 249     | Bridgeport Brass Co. ....   | 20    | Corning Glass Works.....                                     | 288-289  |
| Aldrich Pump Co. ....  | 280     | Brighton Copper Works, Inc....  | 342   | Crane Co. ....   | 251, 305 |
| Allen Bradley Co. ....   | 66      | Bristol Co., The .....  | 282   | Crane Packing Co. ....                                       | 377      |
| Allied Chemical & Dye Corp. Baker Adamson Fine Chemicals, General Chemical Div. .... | 141     | Brown Co. ....  | 321   | Crucible Steel Co. of America                                |          |
| General Chemical Div. ....   | 105     | Brown & Root, Inc. ....   | 113   | Stainless Steel Div.....                                     | 257      |
| Solvay Process Div.....  | 143     | Buffalo Forge Co. ....  | 74    | Cuno Engineering Co. ....                                    | 292      |
| Allis-Chalmers Mfg. Co. General Machinery Div.....                                   | 45      | Buffalo Pumps, Inc. ....  | 383   | Darling Valve & Mfg. Co. ....                                | 47       |
|  | 57, 299 | Cambridge Wire Cloth Co., The .....                                     | 311   | Darnell Corp., Ltd.....                                      | 342      |
| Alloy Fabricators Div. of Continental Copper & Steel Industries, Inc. ....           | 333     | Camco Products, Inc. ....   | 293   | Davenport Machine & Foundry Co. ....                         | 402      |
| Amercoat Corp. ....  | 31      | Carborundum Corp. ....  | 344   | Davis Engineering Corp. ....                                 | 333      |
| American Air Filter Co., Inc. ....   | 40      | Carlson Inc., G. O. ....  | 395   | Davis Regulator Co. ....                                     | 336      |
| American Brass Co., The (Anaconda) ....  | 153     | Carpenter Steel Co. Alloy Tube Div. ....                                | 217   | Day Company, The ....  | 234      |
| American Cyanamid Co. ....   | 134-135 | Carrier Corp. ....  | 127   | Dean Products Inc. Thermo Panel Div.....                     | 404      |
| ACF Industries, Inc. Industrial Products Div.....                                    | 36      | Cash-Standard ....  | 338   | DeLaval Separator Co., The....                               | 219      |
| Valve Div. ....  | 28      | Celanese Corp. of America....   | 247   | DeLaval Steam Turbine Co. ....                               | 33       |
| American Chain & Cable, Helicoid Gage Div. ....                                      | 317     | Century Electric Co. ....   | 83    | Dings Magnetic Separator Co. ....                            | 384      |
| American Hard Rubber Co. ....  | 203     | Chapman Valve Mfg. Co., The. ....                                       | 276   | Dorr-Oliver Inc. ....  | 102-103  |
| American Locomotive Co. Alco Products Div. ....                                      | 399-340 | Chase Brass & Copper Co. ....   | 151   | Dow Chemical Co. Saran Lined Pipe .....                      | 32       |
| American Machine & Metals, Inc. Niagara Filters Div. ....                            | 304     | Chemical & Power Products, Inc. ....                                    | 320   | Dow Corning Corp. ....                                       | 297      |
| American Norit Co., Inc. ....  | LB353   | Chem. Pump Corp. ....   | 53    | Dowell Inc., A Subsidiary of The Dow Chemical Co. ....       | 27       |
| American Optical Co. ....  | 164     | Chemsteel Construction Co. Inc. ....                                    | 353   | Dracco Corp. ....  | 82       |
| American Wheelabrator & Equipment Corp. ....   | 65      | Chicago Bridge & Iron Co. ....  | 133   | Ducon Co., The ....  | 398      |
| Ampco Metals, Inc. ....  | 22-23   | Chiksan Co. ....  | 229   | duPont de Nemours & Co., Inc., E.I. Polychemicals Dept. .... | 213      |
| Armco Steel Corp. ....   | 96      | Childers Mfg. Co. ....  | 222   | Durabla Mfg. Co. ....  | 388      |
| Aqua-Matic, Inc. ....  | 370     | Clark Bros. Co. ....  | 49    | Duraloy Co. ....   | 368      |
| Bailey Meter Co. ....  | 246     | Cleveland Vibrator Co. ....   | 334   | Duriron Co. ....   | 227      |
| Baker & Adamson Products, General Chemical Div., Allied Chemical & Dye Corp. ....    | 141     | Cleveland Wire Cloth & Mfg. Co. ....                                    | 397   | Eclipse Fuel Engineering Co. ....                            | 296, 336 |
| Baldwin-Lima-Hamilton Corp. ....   | 80      | Cochrane Corp. ....   | 334   | Eimco Corp., The ....  | 131      |
| Beckman Instruments, Inc. Beckman Div. ....  | 54      | Columbian Bronze Corp. ....   | 353   | Electric Auto Lite Co. Instrument & Gage Div. ....           | 333      |
| Bell & Gossett Co. ....  | 97      | Combustion Engineering, Inc. Raymond Div. ....                          | 306   | Elliott Co. ....   | 325      |
| Bemis Bro. Bag Co. ....  | 327     | Consolidated Engineering Corp. ....                                     | 71    | Enjay Co., Inc. ....   | 75       |
| Bethlehem Steel Co. Forge ....   | 159     | Continental Copper & Steel Industries, Inc. Alloy Fabricators Div. .... | 333   | Exact Weight Scale Co., The. ....                            | 296      |
| Shipbuilding Div. ....   | 56      |   |       | Falk Corp. ....  | 41       |
| B.I.F. Industries, Inc. Proportioneers, Inc. ....                                    | 101     |   |       | Fenwal, Inc. ....  | 152      |
|  |         |   |       | Filtration Engineers, Inc. ....                              | 380-381  |
|  |         |   |       | Firestone Tire & Rubber Co. Firestone Plastics Div. ....     | 166      |
|  |         |   |       | Fisher Governor Co. ....                                     | 161      |
|  |         |   |       | Fletcher Works, Inc. ....                                    | 296      |

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|   |           |
|---|-----------|
| Foster Wheeler Corp.                                      | 129       |
| Foxboro Co., The  | 60        |
| Frantz Co., Inc., S. G.                                   | 298       |
| Fuller Co.  | 69        |
| Garlock Packing Co.                                       | 322       |
| Gas Atmospheres Inc.                                      | 345       |
| General American Transp. Corp.                            | 115       |
| General Chemical Div., Allied Chemical & Dye Corp.        | 105       |
| General Electric Co.                                      | 67abcdef  |
| General Mills, Inc.                                       |           |
| Chemical Div.   | 145       |
| Girdler Co., The  | 2nd Cover |
| Glitsch & Sons Inc., Fritz W.                             | 308       |
| Globe Steel Tubes Co.                                     | 269       |
| Goodrich Chemical Co.                                     |           |
| Geon Div.   | 9         |
| Goslin Birmingham Mfg. Co., Inc.                          | 148       |
| Goulds Pumps, Inc.  | 319       |
| Grace Chemical Co.  | 263       |
| Grace & Co., W. R.  |           |
| Davison Chemical Corp. Div.                               | 73        |
| Graver Tank & Mfg. Co., Inc.                              | 93        |
| Great Lakes Carbon Corp.                                  |           |
| Dicalite Div.   | 51        |
| Grinnell Co., Inc.  | 8         |
| Griscom-Russell Co., The                                  | 19        |
| Gustin-Bacon Mfg. Co.                                     | 34        |
| Hammel-Dahl Co.   | 169       |
| Hapman Conveyors, Inc.                                    | 330       |
| Hardinge Co., Inc.  | 386       |
| Harshaw Chemical Co., The                                 | 88        |
| Haynes Stellite Co., Div. of Union Carbide & Carbon Corp. | 225       |
| Hercules Powder Co.                                       | 223       |
| Heyden Chemical Corp.                                     | 139       |
| Hills-McCanna Co.   | 372       |
| Hooker Electrochemical Co.                                | 30        |
| Independent Engineering Co.                               | 297       |
| Industrial Process Engineers                              | 343       |
| Ingersoll-Rand  | 123       |
| International Engineering, Inc.                           | 67        |
| International Nickel Co., Inc., The                       | 147, 156  |
| International Paper Co.                                   | 352       |
| Jeffrey Mfg. Co.  | 61        |
| Jelliff Mfg. Co., C. O.                                   | LB297     |
| Jenkins Bros.   | 76        |
| Johns-Manville Corp.                                      |           |
| Celite Filter Aids Div.                                   | 137       |
| Insulation  | 237       |
| Kaiser Engineers, Div., Henry J. Kaiser Co.               | 160       |
| Kelley & Co., O. G.                                       | 26        |
| Kemp Mfg. Co., C. M.                                      | 231       |
| Kerrigan Iron Works, Inc.                                 | 312       |
| Kidde & Co., Inc., Walter                                 | 351       |
| Kinney Mfg. Co.   | 125       |
| Klinger Limited, Richard                                  | 233       |
| Koppers Co., Inc.   |           |
| Engineering & Construction Div.                           | 48        |

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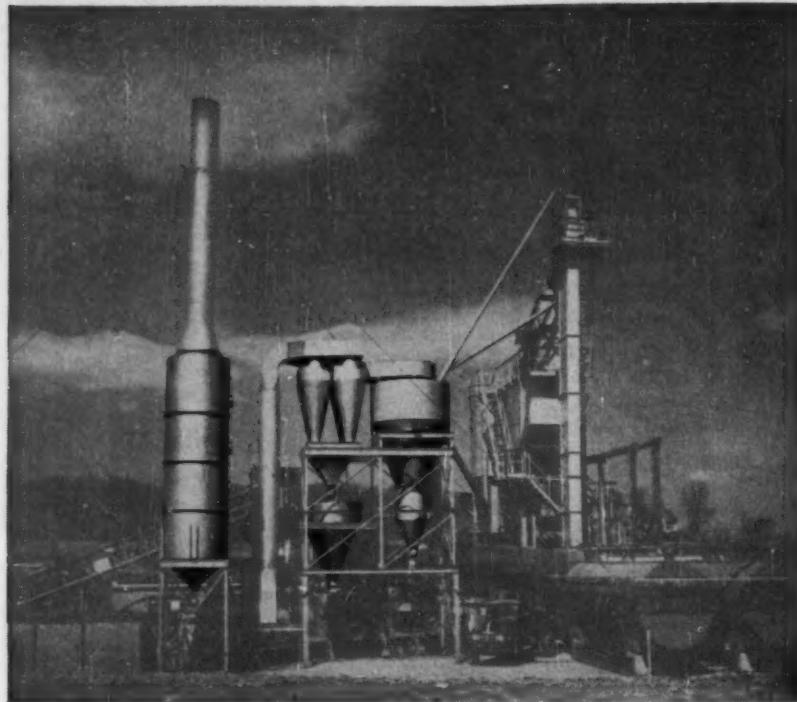
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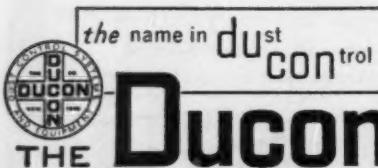


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ADVERTISERS . . .

|                                     |        |
|-------------------------------------|--------|
| LaLabour Co., Inc., The.....        | 168    |
| Ladish Co.                          |        |
| Tri-Clover Div. ....                | 58     |
| Lapp Insulator Co.                  |        |
| Porcelain Process.....              | 38     |
| Pulsafeeder .....                   | 62     |
| Leeds & Northrup Co. ....           | 277    |
| Leslie Co. ....                     | 345    |
| Link Belt Co. ....                  | 13, 89 |
| Liquidometer Corp., The.....        | 335    |
| Litton Engineering Laboratories.    | 294    |
| Louisville Dryer Div., General      |        |
| American Transportation Corp.       | 115    |
| Lukens Steel Co. ....               | 241    |
| Mahon Co., The R. C. ....           | 211    |
| Mallinckrodt Chemical Works..       | 259    |
| Manning, Maxwell & Moore, Inc. .... | 278    |
| Mark & Co., Clayton.....            | 298    |
| Master Electric Co., The            |        |
| Third Cover                         |        |
| McGraw-Hill Book Co. ....           | 291    |
| McNally-Pittsburg Mfg. Corp....     | 371    |
| Mears Kane Ofeldt, Inc. ....        | 335    |
| Merco Centrifugal Co. ....          | 295    |
| Merrick Scale Mfg. Co. ....         | 353    |
| Metalweld Inc. ....                 | 353    |
| Midwest Piping & Supply Co....      | 46     |
| Miehle-Dexter Super Charger a       |        |
| Div. of The Dexter Folder Co.       | 389    |
| Miller & Son Inc., Franklin P. .... | 353    |
| Miller & Son, Franklin P. ....      | 294    |
| Minneapolis-Honeywell Regulator     |        |
| Industrial Div. ....                | 14-15  |
| Mixing Equipment Co., Inc. ....     | 117    |
| Murray Mfg. Co., D. J. ....         | 294    |
| Nagle Pumps, Inc. ....              | 402    |
| Nash Engineering Co. ....           | 78     |
| National Aluminate Corp. ....       | 331    |
| National Carbon Co., A Div. of      |        |
| Union Carbide & Carbon              |        |
| Corp. ....                          | 167    |
| National Filter Media Corp....      | 367    |
| National Foam System, Inc....       | 39     |
| National Petro-Chemicals Corp..     | 12     |
| Neptune Meter Co. ....              | 390    |
| Neville Chemical Co. ....           | 154    |
| Newark Wire Cloth Co. ....          | 378    |
| New York State Department of        |        |
| Commerce .....                      | 369    |

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|  |            |
|--|------------|
| Niagara Alkali Co.                         | 243        |
| Norton Co.                                 | 29         |
| Ohio Injector Co., The                     | 346        |
| Olin-Mathieson Chemical Corp.              |            |
| Industrial Chemicals Div.                  | 107        |
| Owens Corning-Fiberglas                    | 391        |
| Pangborn Corp.                             | 379        |
| Partlow Corp., The                         | 318        |
| Patterson Kelley Co., Inc., The            | 111        |
| Penberthy Injector Co.                     | 209        |
| Perkin-Elmer Corp., The                    | 239        |
| Permutit Co.                               | 44         |
| Pfaudler Co.                               | Back Cover |
| Philadelphia Gear Works, Inc.              | 253        |
| Pittsburgh Lectrodryer Corp.               | 25         |
| Powell Co., The Wm.                        | 261        |
| Pratt & Whitney Aircraft Div.              |            |
| of United Aircraft Corp.                   | 374        |
| Pressed Steel Co.                          | 298        |
| Proctor & Schwartz, Inc.                   | 350        |
| Proportioneers Div. of B.I.F.              |            |
| Industries, Inc.                           | 101        |
| Pure Carbonic Co. Div.                     |            |
| Air Reduction Co.                          | 249        |
| Pyrene-C-O-Two                             | 18         |
| Raybestos-Manhattan, Inc.                  |            |
| Manhattan Rubber Div.                      | 273        |
| Packing Div.                               | 375        |
| Raymond Div., Combustion Engineering, Inc. | 306        |
| Read Standard Corp.                        |            |
| Bakery-Chemical Div.                       | 350        |
| Revere Copper & Brass, Inc.                | 267        |
| Richardson Scale Co.                       | 149        |
| Rietz Mfg. Co.                             | 335        |
| Robbins & Myers, Inc.                      | 290        |
| Rockwell Mfg. Co.                          | 155        |
| Roots-Connersville Blower Div.             |            |
| of Dresser Industries, Inc.                | 328        |
| Ryerson & Sons, Inc., J. T.                | 170        |
| Saran Lined Pipe Co.                       | 32         |
| Sarco Co., Inc.                            | 205        |
| Schneible Co., Claude B.                   | 295        |
| Schutte & Koerting Co.                     | 68         |
| Selas Corp. of America                     | 72         |
| Sharples Corp., The                        | 119        |
| Shell Chemical Corp.                       | 121        |
| Shippers Car Line Corp.                    | 207        |
| Shriver & Co., Inc., T.                    | 373        |
| Sinclair Chemicals, Inc.                   | 341        |
| Sly Mfg. Co., The W. W.                    | 316        |
| Smith Corp., A. O.                         |            |
| Process Equipment Div.                     | 214-215    |
| Smith Co., Morgan S.                       | 314        |
| Solvay Process Div., Allied                |            |
| Chemical & Dye Corp.                       | 143        |
| Southwestern Engineering Co.               | 55         |
| Sparkler Mfg. Co.                          | 271        |
| Spence Engineering Co., Inc.               | 63         |
| Sperry Co., D. R.                          | 35         |
| Sprout, Waldron & Co., Inc.                | 90         |

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## ADVERTISERS . . .

|  |          |
|--|----------|
| Standard Conveyor Co. ....                             | 329      |
| Standard Oil Co. (Indiana) ....                        | 281      |
| Standard Steel Corp. ....                              | 94       |
| Stanley Co., Inc., W. W. ....                          | 295      |
| Stearns Magnetic, Inc. ....                            | 275      |
| Stokes Machine Co., F. J. ....                         | 77       |
| Struthers Wells Corp. ....                             | 146      |
| Sturtevant Mill Co. ....                               | 64       |
| Sun Shipbuilding & Dry Dock Co. ....                   | 165      |
| Superior Combustion Industries Inc. ....               | 291      |
| Surface Combustion Corp.<br>Heat Treating Div. ....    | 291      |
| Kathabar ....  | 59       |
| Sutton, Steele & Steele, Inc. ....                     | 332      |
| Swenson Evaporator Div., Whit-                         |          |
| ing Corp. ....   | 92       |
| Taber Pump Co. ....                                    | 293      |
| Taylor Instrument Cos. ....                            | 150      |
| Terry Steam Turbine Co. ....                           | 37       |
| Texas Gulf Sulphur Co. ....                            | 287      |
| Thermal Research & Engineering Corp. ....              | 313      |
| Timken Roller Bearing Co. ....                         | 337      |
| Toledo Scale Co. ....                                  | 400      |
| Tranter Mfg. Inc. ....                                 | 50       |
| Traylor Engineering Mfg. Co. ....                      | 43       |
| Trent Tube Co., Crucible Steel Co. of America. ....    | 157      |
| Tri-Clover Div., Ladish Co. ....                       | 58       |
| Tri-Homo Corp. ....                                    | 332      |
| Turner & Haws Engineering Co., Inc. ....               | 21       |
| Twin Disc Clutch Co. ....                              | 293      |
| Uelling Instrument Co. ....                            | 353      |
| United Chromium, Inc. ....                             | 265      |
| U. S. Electrical Motors, Inc. ....                     | 79       |
| U. S. Gasket Co. ....                                  | 310, 324 |
| U. S. Rubber Co.<br>Mechanical Goods Div. ....         | 286      |
| U. S. Steel Corp.<br>Products Div. ....                | 24       |
| U. S. Stoneware Co., The. ....                         | 98       |
| Viber Co. ....   | 315      |
| Viking Pump Co. ....                                   | 332      |
| Vogt Machine Co., Henry. ....                          | 85       |
| Vulcan Iron Works. ....                                | 42       |
| Wagner Electric Corp. ....                             | 86       |
| Wall Colmonoy Corp. ....                               | 326      |
| Walworth Co., The. ....                                | 284-285  |
| Wedgeplug Valves Co., Inc. ....                        | 70       |
| Welding Fittings Corp. ....                            | 10       |
| Welsbach Corp., The. ....                              | 81       |
| Western Precipitation Corp. ....                       | 235      |
| Westinghouse Electric Corp.<br>34a-b-c-d-e-f-g-h       |          |
| West Point Mfg. Co., Wellington Sears Subsidiary. .... | 162      |

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## ADVERTISERS . . .

|  |     |
|--|-----|
| Wilfley & Sons, A. R. ....                       | 17  |
| Williams Patent Crusher &<br>Pulverizer Co. .... | 84  |
| Willson Products, Inc. ....                      | 399 |
| Wing Mfg. Co., L. J. ....                        | 392 |
| Worthington Corp.<br>Centrifugal Div. ....       | 158 |
| Compressor Div. ....                             | 283 |
| Wyandotte Chemicals Corp.<br>66a-b-c-d, 279      |     |

Yarnall-Waring Co. .... 95

## SEARCHLIGHT SECTION

(Classified Advertising)

H. E. Hiltz, Mgr.

## PROFESSIONAL SERVICES . . . 364

### EMPLOYMENT

|                                     |     |
|-------------------------------------|-----|
| Positions Vacant . . .              | 354 |
| Selling Opportunities Offered . . . | 354 |
| Positions Wanted . . .              | 354 |
| Selling Opportunities Wanted . . .  | 354 |
| Employment Services . . .           | 354 |

## BUSINESS OPPORTUNITIES . . . 354

### EQUIPMENT

|   |         |
|---|---------|
| (Used or Surplus New)<br>For Sale . . . | 355-363 |
|---|---------|

### WANTED

|                 |     |
|-----------------|-----|
| Equipment . . . | 362 |
|-----------------|-----|

### ADVERTISERS INDEX

|  |          |
|--|----------|
| Aaron Equipment Co. ....                     | 362      |
| American Air Compressor Corp. ....           | 360      |
| Barcan Co., Irving . . .                     | 361      |
| Brill Equipment Co. ....                     | 359      |
| Chemical & Process Machinery Corp. ....      | 360      |
| Chemical Service Corp. ....                  | 362      |
| Consolidated Products Co., Inc. ....         | 355, 362 |
| Drake Personnel Inc. ....                    | 354      |
| Edgar Plastic Kaolin Co. ....                | 358      |
| Equipment Clearing House Inc. ....           | 356      |
| First Machinery Corp. ....                   | 361      |
| Gelb & Son Inc., R. ....                     | 362      |
| Heat & Power Co., Inc. ....                  | 362      |
| Instrument Service Engineering<br>Labs. .... | 358      |
| Kehoe Machinery Corp. ....                   | 360      |
| Lawler Co. ....                              | 356      |
| Loeb Equipment Supply Co. ....               | 362      |
| Loeb & Son, H. ....                          | 356      |
| Luria Bros. Co., Inc. ....                   | 360      |
| Machinery & Equipment Co. ....               | 358      |
| Machinery & Equipment Corp. ....             | 361      |
| Meyer & Son Inc., Wm. W. ....                | 358      |
| Newman Tallow & Soap Machy. Co.<br>Inc. .... | 360      |
| Owens-Corning Fiberglas Corp. ....           | 358      |
| Perry Equipment Corp. ....                   | 357      |
| Plant Equipment Corp. ....                   | 361      |
| Process Plants Service Inc. ....             | 362      |
| Stein Equipment Co. ....                     | 358      |
| Trailmobile Inc. ....                        | 360      |
| Truland Chemical & Eng. Co. ....             | 354      |
| Union Standard Equipment Co. ....            | 356      |
| University of California, The . . .          | 354      |
| Vulcan Detinning Co. ....                    | 356      |
| Weinstein Co. ....                           | 362      |

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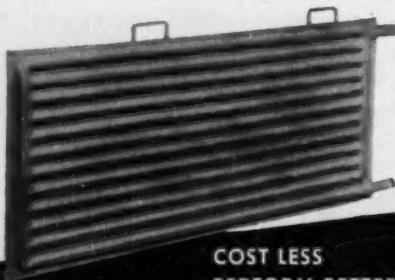
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| 0      | 28  | 65a   | 91   | 129    | 145a   | 219  | 251    | 265a   | 305    | 337    | 377G | 381B | 383J | 388A |
| 7      | 29  | 66b   | 92a  | 131    | 146    | 221  | 262a   | 207    | 308    | 338    | 377H | 381C | 383K | 388B |
| 8      | 40  | 66e   | 93b  | 133    | 148    | 222  | 263    | 269    | 308    | 339-40 | 377I | 381D | 383L | 388C |
| 9      | 41  | 66d   | 92c  | 134-5a | 149    | 223a | 264a   | 271    | 309    | 367    | 377J | 381E | 384  | 388D |
| 10     | 42a | 66a-D | 92d  | 134-5b | 150    | 223b | 264B   | 275    | 310    | 368    | 377K | 381F | 384A | 388E |
| 11     | 42b | 67a   | 93e  | 134-5e | 151    | 223c | 264C   | 276    | 311    | 369    | 377L | 382A | 384B | 388F |
| 12a    | 42c | 67b   | 92f  | 134-5d | 152    | 223d | 264D   | 277    | 312    | 370    | 377M | 382B | 384C | 389A |
| 13b    | 43d | 67e   | 93g  | 134-5e | 153    | 223e | 264B   | 278    | 313    | 371a   | 378  | 383C | 384D | 389B |
| 14c    | 63a | 67d   | 92h  | 134-5f | 154    | 223f | 265    | 279a   | 314    | 371b   | 378A | 382D | 384E | 389C |
| 14-d   | 43b | 67e   | 92i  | 134-5g | 155    | 223g | 266a   | 279b   | 315    | 372    | 378B | 382E | 384F | 389D |
| 15     | 63a | 67f   | 93a  | 134-5h | 156    | 225  | 266B   | 280    | 316    | 373    | 378C | 382F | 384G | 389E |
| 17     | 43d | 63    | 93b  | 134-5i | 157    | 227a | 268C   | 281    | 317    | 375    | 378D | 383G | 384H | 389F |
| 18     | 63a | 69    | 93e  | 134-5j | 158    | 227b | 268D   | R294   | 318    | 376A   | 378E | 383H | 384I | 389G |
| 19     | 63f | 70a   | 94   | 134-5k | 160    | 227c | 266E   | 285    | 319    | 376B   | 378F | 383I | 384J | 389H |
| 20     | 63g | 70b   | 95   | 134-5l | 161a   | 227d | 267    | 286    | 320    | 376C   | 378G | 383J | 384K | 389I |
| 21a    | 44  | 71    | 96a  | 134-6m | 161b   | 227e | 267    | 288-9a | 321    | 376D   | 378H | 383K | 384L | 389J |
| 21b    | 45  | 72    | 96b  | 134A   | 162    | 229  | 268A   | 288-9b | 322    | 376E   | 378I | 383L | 384M | 389K |
| 22-2   | 46  | 73    | 97   | 137    | 163    | 231  | 268B   | L201   | 323    | 376F   | 378J | 383M | 384N | 389L |
| 24     | 47  | 74    | 98   | 139a   | 164    | 232a | 268C   | M201   | 324a   | 376G   | 378K | 383N | 386  | 389C |
| 25     | 48  | 75a   | 101  | 139b   | 164    | 232b | 268D   | L203   | 324b   | 376H   | 379  | 383O | 386a | 389A |
| 26a    | 49  | 75b   | 102  | 139c   | 165a   | 232c | 268a   | M203   | 325    | 376I   | 379A | 383P | 386b | 389B |
| 26b    | 50  | 76    | 107a | 139d   | 167b   | 232d | 269b   | R203   | 326    | 376J   | 379B | 383Q | 386c | 389C |
| 26c    | 51a | 77    | 107b | 139e   | 167c   | 232e | 269a   | L204   | 327    | 376K   | 379C | 383H | 386d | 389D |
| 26d    | 51b | 79    | 107c | 139f   | 167d   | 232f | 269d   | M204   | 328    | 376L   | 379D | 383H | 386e | 389A |
| 26e    | 52  | 80    | 107d | 140A   | 167e   | 232g | 269a   | R204   | 329    | 376M   | 379E | 383T | 386f | 389A |
| 27     | 53  | 81a   | 107e | 140B   | 168    | 239  | 269B   | TL205  | 330    | 376N   | 379F | 383U | 386g | 389C |
| 29     | 54  | 81b   | 111  | 141    | 169    | 241a | 260C   | BL205  | 331    | 376O   | 379G | 383V | 386h | 389D |
| 30     | 54a | 82    | 113  | 142A   | 170    | 241b | 260D   | BL205  | L332   | 376P   | 379H | 383W | 386i | 389E |
| 30     | 55b | 88    | 115  | 142B   | 203a   | 243a | 261    | TL206  | TR233  | 376Q   | 380A | 383X | 386j | 389F |
| 32     | 56a | 84a   | 117a | 143C   | 203b   | 243b | 262a   | BL206  | BR232  | 376R   | 380B | 383Y | 386k | 389A |
| 33     | 56d | 84b   | 117b | 144A   | 203c   | 243c | 262B   | R206   | TL233  | 376S   | 380C | 383Z | 386l | 389B |
| 34     | 57  | 84c   | 117c | 144B   | 207    | 242d | 262C   | BL207  | BL232  | 376T   | 380D | 383Z | 386m | 389C |
| 34A-Ha | 58  | 84d   | 117d | 144C   | 211    | 243a | 262D   | BL207  | R233a  | 376U   | 380H | 383A | 386n | 389D |
| 34A-Hb | 59  | 84e   | 117e | 144D   | 213a   | 243f | 263a   | R207   | BR233b | 376V   | 380F | 383B | 386o | 389E |
| 34A-Hc | 59  | 84f   | 117f | 144E   | 213b   | 243g | 263b   | TL208  | L334   | 376W   | 380G | 383C | 386p | 389F |
| 34A-Hd | 61a | 84g   | 117g | 144F   | 213c   | 243h | 264A   | BL208a | R334   | 377A   | 380H | 383D | 386q | 389G |
| 34A-He | 61b | 85    | 117h | 144G   | 213d   | 243a | 264B   | BL208b | L335   | 377B   | 380I | 383E | 386r | 389H |
| 35     | 62  | 86    | 119  | 214-5a | 246b   | 264C | BL208c | TR235  | 377C   | 380J   | 383F | 386s | 389D | 404  |
| 36a    | 63  | 87    | 121  | 144I   | 214-5b | 247  | 264D   | R208   | TR235  | 377D   | 380K | 383G | 386t | 409  |
| 36b    | 64a | 88    | 123  | 144J   | 214-5c | 248A | 265a   | 299    | L336   | 377E   | 381  | 383H | 386u | 410a |
| 36c    | 64b | 89    | 125  | 145a   | 214-5d | 249  | 265b   | 304    | R336   | 377F   | 381A | 383I | 386v | 410b |
| 37     | 65  | 90    | 127  | 145b   | 217    | 245  |        |        |        |        |      |      |      |      |

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| 140A | 146B | 148B | 180C | 180G | 180K | 253A | 254A | 255A | 256A | 258D | 260D | 263B | 363H | 364C |
| 144A | 146C | 148C | 180D | 180H | 248A | 242B | 248D | 256B | 258A | 360A | 260B | 263C | 264A | 364D |
| 144B | 146D | 180A | 180E | 180I | 260A | 262C | 254C | 256C | 258B | 260B | 260F | 263D | 264B | 264H |

|                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |
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| 40                       | 41                       | 42                       | 43                       | 45                       | 46                       | 47                       | 48                       | 49                       | 50                       | 52                       | 53                       | 54                       | 55                       | 56                       | 57                       | 58                       |                          |

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|--------|-----|-------|------|--------|-------|------|------|--------|-------|--------|------|------|------|------|
| 6      | 23  | 66a   | 91   | 139    | 145e  | 219  | 251  | 265e   | 305   | 327    | 377G | 381B | 381J | 388A |
| 7      | 29  | 66b   | 92a  | 131    | 146   | 221  | 232A | 267    | 306   | 328    | 377H | 381C | 383K | 388B |
| 8      | 40  | 66e   | 92b  | 133    | 148   | 223  | 233  | 269    | 308   | 309-40 | 377I | 381D | 383L | 388C |
| 9      | 41  | 66d   | 92c  | 134-6a | 149   | 223a | 234A | 271    | 309   | 327    | 377J | 381E | 384  | 388D |
| 10     | 42a | 66A-D | 92d  | 134-6b | 150   | 223b | 234B | 275    | 310   | 328    | 377K | 381F | 384A | 388E |
| 11     | 42b | 67a   | 92e  | 134-6c | 151   | 223c | 234C | 276    | 311   | 329    | 377L | 382A | 384B | 388F |
| 12a    | 42c | 67b   | 92f  | 134-6d | 152   | 223d | 234D | 277    | 312   | 3270   | 377M | 382B | 384C | 388A |
| 12b    | 42d | 67c   | 92g  | 134-6e | 153   | 223e | 234E | 278    | 313   | 3271a  | 378  | 382C | 384D | 388B |
| 13a    | 43a | 67d   | 92h  | 134-6f | 154   | 223f | 234F | 279a   | 314   | 3271b  | 378A | 382D | 384E | 388C |
| 14-5   | 43b | 67e   | 92i  | 134-6g | 155   | 223g | 235A | 279b   | 315   | 3272   | 378B | 382E | 384F | 388D |
| 15     | 43c | 67f   | 92j  | 134-6h | 156   | 223h | 235B | 280    | 316   | 3273   | 378C | 382F | 384G | 388E |
| 17     | 43d | 68    | 93e  | 134-6i | 157   | 227a | 236C | 281    | 317   | 3275   | 378D | 382G | 384H | 388F |
| 18     | 43e | 69    | 93a  | 134-6j | 158   | 227b | 236D | R284   | 318   | 3276A  | 378E | 382H | 384I | 388G |
| 19     | 43f | 70a   | 94   | 134-6k | 160   | 227c | 236E | 285    | 319   | 3276B  | 378F | 382I | 384J | 388H |
| 20     | 43g | 70b   | 95   | 134-6l | 161   | 227d | 235F | 286    | 320   | 3276C  | 378G | 382J | 384K | 388I |
| 21a    | 44  | 71    | 96a  | 134-6n | 161b  | 227e | 257  | 288-9a | 321   | 3276D  | 378H | 382K | 384L | 388J |
| 21b    | 45  | 72    | 96b  | 136A   | 162   | 229  | 255A | 288-9b | 322   | 3276E  | 378I | 382L | 384M | 388A |
| 22-3   | 46  | 73    | 97   | 137    | 163   | 231  | 258B | L291   | 323   | 3276F  | 378J | 382M | 384N | 388B |
| 24     | 47  | 74    | 98   | 139a   | 164   | 233a | 258C | M291   | 324a  | 3276G  | 378K | 382N | 384P | 388C |
| 25     | 48  | 75a   | 101  | 139b   | 166   | 233b | 258D | L293   | 324b  | 3276H  | 379  | 382O | 384Q | 388D |
| 26a    | 49  | 75b   | 106  | 167a   | 167a  | 233e | 256a | M293   | 325   | 3276I  | 379A | 382P | 386b | 388B |
| 26b    | 50  | 76    | 107a | 139d   | 167b  | 233d | 256b | R293   | 326   | 3276J  | 379B | 382Q | 386c | 389C |
| 26c    | 51a | 77    | 107b | 139e   | 167c  | 234  | 256c | L294   | 327   | 3276K  | 379C | 382R | 386d | 389D |
| 26d    | 51b | 79    | 107e | 139f   | 167d  | 235  | 256d | M294   | 328   | 3276L  | 379D | 382S | 386e | 389E |
| 26e    | 52  | 80    | 107d | 140A   | 167e  | 237  | 260A | R294   | 329   | 3276M  | 379E | 382T | 386f | 389F |
| 27     | 53  | 81a   | 107e | 140B   | 168   | 239  | 260B | TL295  | 320   | 3276N  | 379F | 382U | 386g | 389G |
| 28     | 54  | 81b   | 111  | 141    | 169   | 241a | 260C | BL295  | 321   | 3276O  | 379G | 382V | 386h | 389H |
| 29     | 55a | 82    | 113  | 142A   | 170   | 241b | 260D | R295   | 322   | 3276P  | 379H | 382W | 386i | 389E |
| 30     | 55b | 83    | 115  | 142B   | 203a  | 243a | 261  | TL296  | TR332 | 3276Q  | 380A | 382X | 386j | 389F |
| 32     | 55c | 84a   | 117a | 142C   | 203b  | 243b | 262a | BL296  | TR332 | 3276R  | 380B | 382Y | 386k | 389A |
| 33     | 55d | 84b   | 117b | 144A   | 203c  | 243c | 263B | R296   | TL293 | 3276S  | 380C | 382Z | 386l | 389B |
| 34     | 57  | 84e   | 117c | 144B   | 207   | 243d | 262C | TL297  | BL293 | 3276T  | 380D | 383m | 386m | 389C |
| 34A-Ha | 58  | 84d   | 117d | 144C   | 311   | 243e | 263D | BL297  | R293a | 3276u  | 380E | 383n | 386n | 389D |
| 34A-Hb | 59  | 84e   | 117e | 144D   | 312a  | 243f | 263a | R297   | R333b | 3276v  | 380F | 383o | 386s | 389E |
| 34A-Hc | 60  | 84f   | 117f | 144E   | 312b  | 243g | 263B | TL298  | L334  | 3276w  | 380G | 383p | 386b | 389F |
| 34A-Hd | 61a | 84g   | 117g | 144F   | 312c  | 243h | 264A | BL298a | R334  | 3277A  | 380H | 383q | 386d | 389G |
| 34A-He | 61b | 85    | 117h | 144G   | 313d  | 243i | 264B | BL298b | L335  | 3277B  | 380I | 383r | 386d | 389H |
| 35     | 62  | 86    | 119  | 144H   | 314-a | 245b | 264C | BL298c | TR335 | 3277C  | 380J | 383f | 386e | B404 |
| 36a    | 63  | 87    | 121  | 144I   | 314-b | 245c | 264D | R298   | BR335 | 3277D  | 380K | 383G | 386F | 400  |
| 36b    | 64a | 88    | 123  | 144J   | 314-c | 245d | 265a | 290    | L336  | 3277E  | 381  | 383H | 386G | 410a |
| 36c    | 64b | 89    | 125  | 145a   | 314-d | 245d | 265B | 304    | R336  | 3277F  | 381A | 383I | 386H | 410b |
| 37     | 86  | 90    | 127  | 145b   | 317   |      |      |        |       |        |      |      |      |      |

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| 140A | 146B | 146B | 150C | 150G | 150K | 252A | 254A | 256A | 256E | 258D | 260D | 262B | 262E | 264C |
| 144A | 146C | 146C | 150D | 150H | 248A | 252B | 254B | 256B | 258A | 260A | 260E | 262C | 264A | 264D |
| 144B | 146D | 150A | 150E | 150I | 250A | 252C | 254C | 256C | 258B | 260B | 260F | 262D | 264B | 264E |
| 146A | 150A | 150B | 150F | 150J | 250B | 252D | 254D | 256C | 260C | 262A |      |      |      |      |

|                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                          |
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| 1                        | 2                        | 3                        | 4                        | 15                       | 17                       | 21                       | 22                       | 25                       | 26                       | 28                       | 29                       | 33                       | 34                       | 35                       | 36                       | 37                       | 38                       |
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|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 40                       | 41                       | 42                       | 43                       | 45                       | 46                       | 47                       | 48                       | 49                       | 50                       | 52                       | 53                       | 54                       | 55                       | 56                       | 57                       | 58                       |
| <input type="checkbox"/> |

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# P.S. Did you miss anything in this issue?

Here's a list to help you make a quick check:

**Chemicalizer** ..... 99

**What's Happening In** .....

Polyvinyl Alcohol ..... 108  
Air Pollution ..... 112  
Oil Refinery ..... 116  
Spray Drying ..... 118  
Pelletizing Process .. 120

Ion-Exchange ..... 122  
Pressure Drop ..... 126  
Expense Formula ... 130

**Chemicals & Raw Materials**  
Separate Men From  
Boys ..... 138  
Index ..... 138

## Feature Articles

Keep Cost Estimates Realistic. By C. A. Butler, Jr. .... 171

Gas Turbines for Process Use—I. By Benjamin Miller ..... 175

Guide for Picking the Right Bid. By E. E. Ludwig and A. F. Shorkey.... 181

Solve for Payout Time. By E. Yanagisawa ... 185

Counter-Flow Cooling Towers. By George Karnofsky ..... 192

How to Design Gas-Cooling Towers—II. By G. H. P. Bras ..... 195

## CE Refresher

Catalytic Vapor Phase Reactions—I. By Thomas E. Corrigan..... 199

## Plant Notebook

Read Your Slide Rule to Four Figures. By Royes Salmon ..... 204

## You & Your Job

Employment Prospects for 1955 ..... 216

## Corrosion Forum

Rubber Hose Gets Better. By J. A. Muller.. 224  
Lead Lined Plus.... 230

## Tomorrow's Technology

Reactor Scrubs NH<sub>3</sub> From Coke Oven Gas... 236  
Chlorination Via Photochemistry ..... 240  
Your Checklist ..... 242

## Equipment News

Ball Transmission Tilts to Vary Speed..... 248  
Index ..... 250  
Equipment Cost Index 250  
Two-in-One Compressor. 252

## Chemical Economics

Why 1955 Will Be Chemicals' Best Year... 266  
Consumption Index... 268  
Fertilizers: Piling Up? 270

## Pictured Flowsheet

Semi-Chemical Pulp . 300

## Other Departments

Book Reviews ..... 320  
Convention Calendar. 114  
Firms In the News... 326  
Names in the News... 307  
Recent Pamphlets... 324

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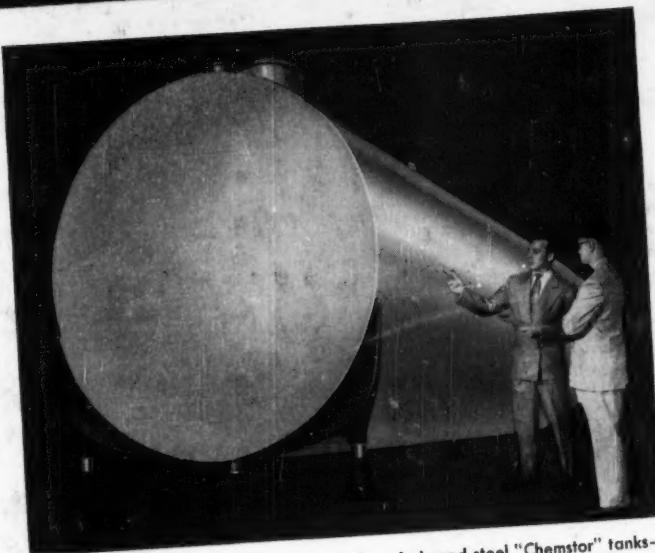
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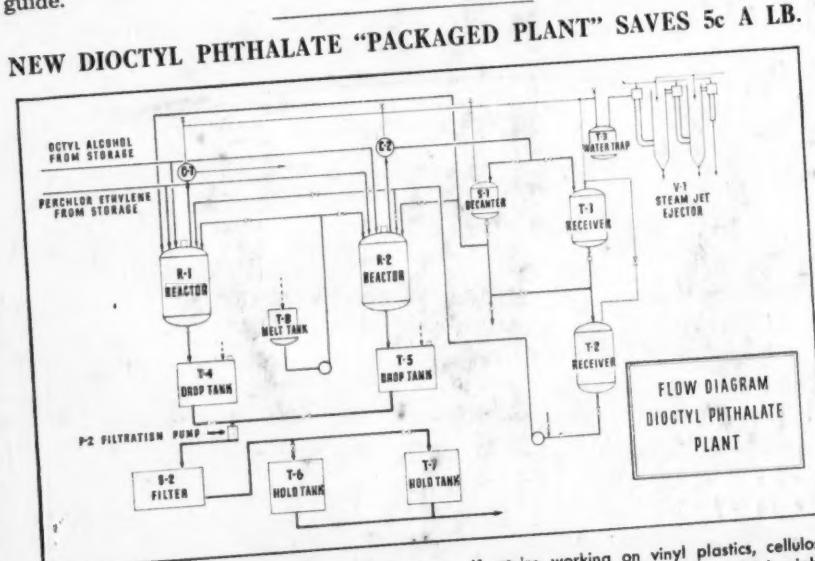
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"Chemstor" tanks cost you little—as low as 25¢ per gallon volume in the largest size. Both glass and steel are low-cost materials, the manufacturing method is not expensive, the tanks are simple in design—and built as standard models which can be produced quickly.

For low-cost storage, with product protection and fast cleaning, it will pay you to learn more about "Chemstor." Write for bulletin.



This new system—offered as a 100% engineered and delivered package by Pfaudler—enables you to realize great savings by making your own plasticizers. Usually pays for itself within six months.

If you're working on vinyl plastics, cellulose esters, synthetic rubber, or other plasticizing jobs, write for detailed information on "Plasticizer Process."

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THE PFAUDLER CO.  
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